Service Manual

AVL OMNI™ 1-9

Modular System

CH3496
Rev. 9.0, May 2000

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First Edition: June 1995

- Important Information! - Important Information! -

This **Service Manual** contains important **warnings and safety** instructions to be observed by the user.

This instrument is only intended for one area of application which is described in the instructions. The most important prerequisites for application, operation and safety, are explained to ensure smooth operation. No warranty or liability claims will be covered if the instrument is applied in areas other than those described or if the necessary prerequisites and safety measures are not observed.

The instrument is only to be operated by qualified personnel capable of observing these prerequisites.

Only accessories and supplies either delivered by or approved by AVL are to be used with the instrument.

Due to this instrument operating principle, analytical accuracy not only depends on correct operation and function, but also upon a variety of external influences beyond manufacturers control. Therefore the test results from this instrument must be carefully examined by an expert, before further measures are taken based on the analytical results.

Instrument adjustment and maintenance with removed covers and connected power, are only to be performed by a qualified technician who is aware of the dangers involved.

Instrument repairs are only to be performed by the manufacturer or qualified service personnel.

Explanation:

This symbol is located on the inside of the instrument:

"Refer to the Operator's Manual / Service Manuals".

Symbol for instrument type B:

An instrument of the B-type falls under safety categories I, II or III, or has an internal power supply, providing the required insulation against discharge current and reliable ground connections.

- Important Information! - Important Information! -

- Operating Safety Information -

* The instrument falls under Safety Category I.
* The instrument belongs to Type B.
* The instrument is designed as a conventional device (of closed, not waterproof type).
* Do not operate the instrument in an explosive environment or in the vicinity of explosive anesthetic mixtures containing oxygen or nitrous oxide.
* The instrument is suitable for continous operation.

CAUTION:

- The power cord may be plugged only into a grounded socket. When using an extension cord, make sure it is properly grounded.
- Any rupture of the ground lead inside or outside the instrument or a loose ground connection can render hazardous operation of the instrument. Intentional disconnection of the grounding is not permitted.
- While changing the fuses, make sure that the fuses used, are of the specified type and rating in every case. Never use repaired fuses or short-circuit the fuse holders.

- Operating Safety Information -

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Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, August 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
General information							
Important information					•, Δ	Δ	
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Device leakage current measurements - Testing after field repair and modifications							
Decontamination			Δ	Δ	•, Δ		Δ

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
General information							
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Warnings							
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- • Modification (previous states of revision see chapter 10, "Previous revision levels")
- Δ New or addition !

1 INTRODUCTION

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1 Introduction

General information

This Service Manual includes all information and data necessary for repair and maintenance of the AVL OMNI™.
In order to fully understand the described procedures in this manual, it is necessary to be familiar with the manner of function and handling of the analyzer. This information can be obtained from the Operator's Manual.
Proper functioning of the AVL OMNI™ can only be ensured when maintenance and repairs are performed, according to the procedures described in this Service Manual. The use of original AVL parts and suggested materials is also necessary.
The order numbers of spare parts are located in the spare part list.
Chapter 2 of this Manual includes a summary of all mechanical or electronic modifications, as well as available software versions.

Important information

Information in this manual marked "**NOTE**", describes situations or hazards which can damage or cause malfunctioning of the analyzer.

- Use a stable, level working environment (max. ± 1 degree inclination when bottles are inserted).
- Prevent vibrations, direct sunlight and strong electromagnetic fields (Electro motors, transformers, x-ray devices, immediate vicinity of mobile telephones e.g.).
- Allow approx. 10 cm space around the analyzer for air circulation and electrical supply.
- Ambient temperature: +15 °C to + 31 °C
- Relative humidity:

  AVL OMNI™ 1 - 6, up to 95 %

  AVL OMNI™ 7, 8, 9:
  up to 70 %, if temp. < 31 °C, (MC Temp. 25 °C)
  up to 83 %, if temp. < 28 °C, (MC Temp. 25 °C)
  up to 90 %, if temp. < 27 °C, (MC Temp. 25 °C)
  up to 95 %, if temp. < 31 °C, (MC Temp. 30 °C)
- The power supply must be between 100 - 240 V AC (+6%/-10% permissible tolerance). No setting is necessary.
- Avoid leakage of fluids inside the analyzer. This can lead to damage in the electronics.
- Only use damp tissue or cotton swabs to clean the analyzer.
- Complete service and repair tasks as described in this manual. Improper service and repairs can result in loss of warranty rights.

- Only use proper tools and test facilities for service and repairs.
- Replace damaged fuses with approved or original types only.
-

  Electrostatic Sensitive Device
  Packages with this label should be opened by qualified personnel only.

Warnings

Warnings in this Manual are marked with "**CAUTION**" and describes situations or potential dangers which can be hazardous for persons doing maintenance or service tasks.

- Never use the analyzer near easily inflammable or explosive gases (e.g. anaesthesic gases etc.).
- Always connect the analyzer to a grounded 2-pole socket.
- Replace immediately a damaged power plug or cable.
- Before opening the rear cover, turn off the analyzer and unplug the main cable.
- Components of the AVL OMNI™ such as tubes, Waste container, Fill port etc. contain biological substances after use, resulting in potential sources of infection. Handle these components with care and avoid contact with the skin.
  Use plastic gloves.
-

  Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain remnants of biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin.
  Use rubber gloves.

ESD protective measures

Components sensitive to electrostatic discharge (ESD).
Packages with this label should be opened by trained personnel only.

Explanation of the Phenomenon

Friction of 2 insulators produces triboelectricity on the surface of the insulators (physical phenomenon of charge separation).

Examples:

- Shoes with rubber soles:
  Walking causes friction. Person is charged via ground. Touching an object (e.g. door handle) causes a discharge.
- Synthetic clothing:
  Spark discharge is audible and visible in the dark.

The drier the air, the stronger the frictional electricity. In humid air, especially when saturated with water vapor, generation of static electricity is generally low. Thus, generation of ESD phenomena is especially strong during the winter months (Northern Hemisphere), in centrally heated rooms with low humidity.

Impact of static electricity on assemblies

When an electrostatically charged person touches an assembly, a discharge may occur via the pins of an IC or semiconductor component. The resulting voltages may cause damage to the component, if this charge is discharged to ground (e.g. if the component is connected to power and to protective ground; this can happen, even if the device is turned off as long as it is connected to power). Critical situations occur during repair or testing of components, if the latter are placed on a more or less conducting surface (e.g. table top) and are touched by a ”charged” person. Again it is possible that the charge is discharged via a critical pin.

Why is ESD protection so important today

In the past, current-control semiconductors (TTL, normal transistor, etc.) were used predominantly.
Today the principle of voltage control in MOS, CMOS components is used practically exclusively. The voltages generated by ESD (up to several kV) destroy sensitive inputs and cause damage.
In addition, with continuously decreasing distances within the ICs, with thinner internal connections, continuously decreasing maximum permissible input voltages, the effects of possible discharges become more and more critical.

How can ESD protection be ensured?

All personnel working with electronic assemblies should continously discharge themselves. This can be done by observing the following measures (these guidelines apply particularly to work on the components, since this involves touching the pins; e.g. on MOS transistors, a protective ring connecting all pins must be removed after soldering).

- ESD wrist bands should be worn (special wrist bands connected to protective ground).
- Repair and testing of assemblies should be performed only on tables with ESD mats[1].
- Components should be touched only at the edges (e.g. like a photograph).
- Assemblies should be transported in ESD packaging[1] or corresponding storage/transport containers[1] (use original packaging!).
- Avoid wearing shoes with rubber soles or synthetic clothing in work shops where electronic components are repaired.
- If needed, use humidifiers to provide optimal humidity.
- Assemblies or components should not be touched by hand after completion of testing.
- Assemblies or components returned for repair must be packaged in ESD packaging to avoid additional damage which could lead to a mis-interpretation of the original error source.

Conclusion

Of course, not all printed circuit boards or electronic assemblies must be handled as critical components. An electronic board containing only plug-in connectors does not require ESD packaging.
If in doubt, please observe ESD protective measures.

[1] These are materials with a very low defined conductivity (10^{12} Ohm). These materials will not generate triboelectricity and the component will not be damaged.

Device leakage current measurements - Testing after field repair and modifications

NOTE: *Measurements may be performed by qualified personnel only, since protective measures may be ineffective during device leakage current measurements (e.g., protective ground connector).*

These measurement procedures and limit values are based on the standard IEC 1010-1/A2: “Safety requirements for electrical equipment for measurement, control and laboratory use.“ EN 61010-1/A2 and IEC 1010-1/A2 respectively, are the internationally applicable standards.

Measurement instruments used

During purchase and use of the measuring device it must be ensured that the device used meets the respective requirements.(correct measuring circuits). The measuring device is to be tested periodically by a certified testing agency, i.e. it has to be calibrated and labeled as a testing instrument (with expiration date).

Device leakage current measurement according to EN 61010-1 (IEC 1010-1):

According to IEC 1010-1, Appendix A and K “Measuring circuit for ACCESSIBLE current“.)

Permissible limit value for accessible parts:

3.5 mA at max. supply voltage.

NOTE: *The device leakage current measurement according to IEC 1010-1 „Measuring circuits for accessible currents“, which is performed after repair work in the field, is not subject to the same limit values as the leakage current measurement as part of the routine test during the final inspection of the instruments at the factory. The values measured during the routine test at the factory are documented in the respective “Quality Certificate“.*

IVD Guideline 98/79/EG:

The IVD guideline, which is already effective as EU-Guideline, will attain national applicability in all countries of the European Union in mid 2000. The harmonized standard for the IVD Guideline is EN 61010-1/A2.

Decontamination/Cleaning

The purpose of this procedure is to minimise the risk when replacing items that are in direct contact with blood.
AVL recommends the following decontamination procedures. Additional decontamination should be performed in accordance with local laboratory regulations.
These decontamination procedures should be performed periodically to minimise the risk of infections (incl. hepatitis virus and HIV).

NOTE: *The use of rubber gloves is recommended!*

The following parts of the device have to be decontaminated:

- Sample drip tray and fill port
- T&D disk
- Touch screen
- Surfaces
- MSS tubes
- Electrodes, measuring chamber (internal cleaning with Solution 6 – if available – possible. See AVL OMNI™ Operator's Manual, chapter 9, section "Module Cleaning").

NOTE: *Do not decontaminate the MSS cassette.*
In case of electrode blockage with blood, replace the MSS cassette.

Disinfectants

NOTE: *Use liquid disinfectants only (e.g. AVL-Deproteinizer, Solution 6). Do not use sprays!*

AVL Deproteinizer

Composition

Aqueous solution of NaOCl containing ≤ 2% active chlorine.

Hazards identification

Due to the basic and oxidizing character of the reagent ("Deproteinizer") local irritations may occur after contact with eyes, skin or mucous membranes.

First aid measures

After inhalation:	fresh air, drink plenty of water
After skin contact:	rinse with plenty of water, remove contaminated clothes
After eye contact:	rinse with plenty of water, consult a doctor
If swallowed:	drink plenty of water, avoid vomiting, consult a doctor

NOTE: *When Deproteinizer is handled and used properly, no ecological problems are to be expected.*

Commercial disinfectant

A commercially available alcoholic disinfectant containing aldehyde should be used (e.g.: Meliseptol). Please refer to the product description of the surface disinfectant.

NOTE: *Do not use the disinfectant for internal decontamination!*

Decontamination

For external decontamination AVL Deproteinizer is especially recommended. You may also use a commercially available alcoholic disinfectant containing aldehyde.

In case of heavy contamination, the sample drip tray may be exchanged and discarded in accordance with local regulations.
Before exchanging the sample drip tray, decontaminate it using a cotton swab saturated in disinfectant. Lift the drip tray and pull it out toward the bottom.

Sample drip tray

The sample drip tray prevents contamination of the bottle compartment (in case of improper sample introduction). Decontaminate a dirty sample drip tray using a cotton swab saturated in disinfectant.

Procedure

1. Activate the function program
   "**Options - Cleaning - Interrupt for cleaning**".
2. Open bottle compartment cover.
3. Pull sample drip tray down and out.
4. Clean/decontaminate and decontaminate or replace it.
5. Close bottle compartment cover.
6. Press the key "**Interrupt**" upon completion of this maintenance procedure.

The system performs a washing/drying procedure and will return to the "**Ready**" screen.

Fill port

Decontaminate fill port using a cotton swab saturated in disinfectant.

Procedure

1. Activate the function program
   "**Options - Cleaning - Interrupt for Cleaning**".
2. Decontaminate fill port.
3. Press the key "**Interrupt**" upon completion of this maintenance procedure.

The system performs a washing/drying procedure and will return to the "**Ready**" screen.

Or

1. Open bottle compartment cover.
2. Pull sample drip tray down and out.
3. Remove the fill port adapter (see Fig. 1) by turning it downward.

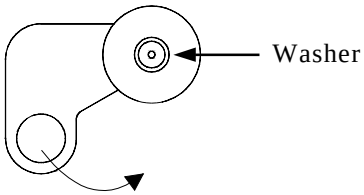

Fig. 1: Fill port / fill port adapter

4. Decontaminate the washer of the fill port, the whole fill port and the top surface of the sample inlet path, using a cotton swab saturated in disinfectant.
5. Assemble the fill port and the sample drip tray.
6. Close bottle compartment cover.
7. Press the key "**Interrupt**" upon completion of this procedure.

The system performs a washing/drying procedure and will return to the "**Ready**" screen.

T&D disk

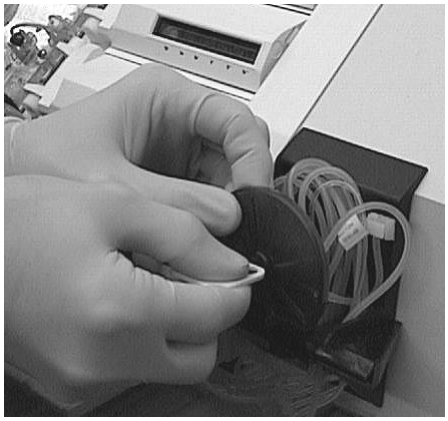

Fig. 2: Decontaminate T&D disk

Decontaminate the individual T&D positions as follows:

Procedure

1. Activate the function program
   "**Options - Cleaning - Interrupt for Cleaning**".
2. Open bottle compartment cover and analyzer cover.
3. Pull sample drip tray down and out.
   Clean the sample drip tray under running water and decontaminate it.
4. Remove the fill port adapter (see Fig. 3) by turning it townward.

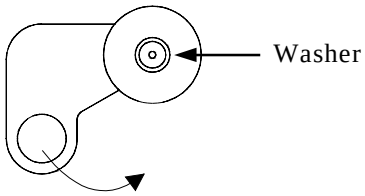

Fig. 3: Fill port adapter

5. Decontaminate the washer of the fill port and the whole fill port using a cotton swab saturated in disinfectant.
6. The fill port adapter can now be used as a tool. Insert the fill port adapter into the slit of the holding disk and turn the holding disk a fourth of a turn to the right or left. At the same time, hold the T&D disk firmly.
7. Remove, clean and decontaminate T&D disk.
8. Assemble T&D disk in reverse order.
9. Assemble sample drip tray.
10. Close bottle compartment cover and analyzer cover.
11. Press the key "**Interrupt**" upon completion of this maintenance procedure.

The system performs a washing/drying procedure and will return to the "Ready" screen.

Touch screen

Procedure

1. Activate the function program
   "**Options - Cleaning - Clean display**".
   (The keys on the screen are deactivated for about 10 seconds!).

NOTE: *Decontaminate with damp cloth only using a disinfectant. Do not use sprays!*

After 10 seconds the screen will return into the active condition.

Surfaces

Decontaminate all outside surfaces including all covers (e.g. measuring chamber covers, bottle compartment covers), as well as the outside surfaces of the AutoQC module (if available), with the disinfectant according local regulations.

MSS tubes

Decontaminate the tubing paths of Solution 1, 3, 5, D and R3[2] with AVL Deproteinizer.

Fig. 4: Remove bottles

1. Activate the function program "**Options - Cleaning - Cleaning of MSS-Tubes**".
2. Open bottle compartment cover.
3. Remove and dispose the bottles 1, 3, 5, D and R.
4. Connect the shutdown tubing set to the corresponding suction tubes (see chapter 3, section "Shutdown"). The tubes with the long rigid ends are connected to Solutions 5, D and R.
5. Put the tubing harness in a container with AVL Deproteinizer. Press the key "**Continue**" and follow the instructions on the screen.
6. Insert new bottles in the corresponding positions.

Electrodes / Measuring Chamber

An internal cleaning with Solution 6 will be performed automatically during a System Calibration after:

- BG / ISE: 1000 sample measurements
- tHb / COOX: 50 sample measurements
- MSS: 5000 sample measurements

An additional cleaning with AVL Deproteinizer should be performed only when the measuring capillary is contaminated (protein residue) or if components of the measuring path are being replaced.

NOTE: *The decontamination procedure is identical to the cleaning procedure. If an electrode is exchanged, it has to be done before the wetting process.*

[2] only, if MSS with Urea (BUN) is measured!

BG measuring chamber

A cleaning of the BG measuring chamber is necessary only, when the QC values of the BG electrode are outside the assay ranges.

An internal cleaning with Solution 6 will be performed automatically during a System Calibration after 1000 sample measurements

Cleaning

Activate the function program
"**Options - Cleaning - Module Cleaning**".

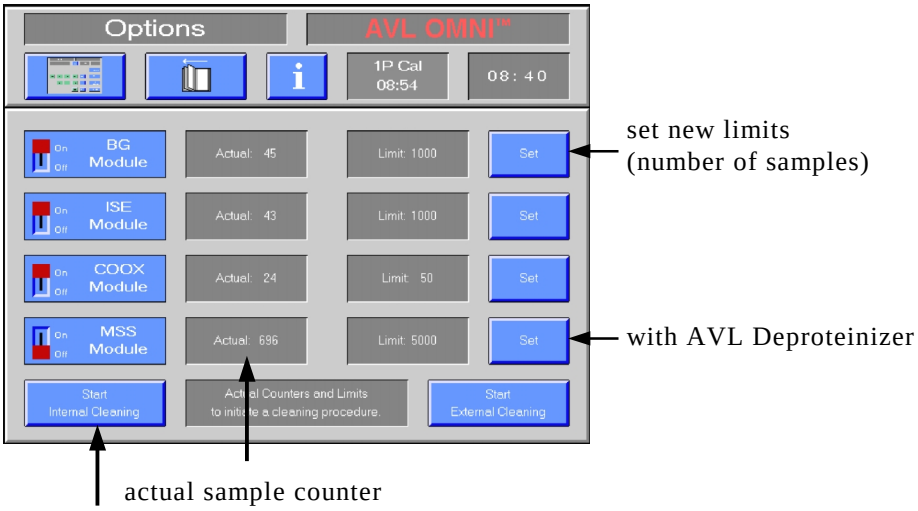

Fig. 5: Module Cleaning

Press "**Start external cleaning**".
The cleaning agent is introduced in the fill port like a sample (syringe or capillary).

Press "**Start internal cleaning**".
If Solution 6 is available, an internal cleaning can also be activated!

Wetting

To wet the BG module after the cleaning process, several measurements (2-3) with whole blood have to be performed.
If that is not possible or the decontamination / cleaning procedure tripped an alarm for a complete module, activate:
"**System - Util - Analyzer Actions - Fluid Actions - Wetting Electrodes - Automatic / Manually**".

NOTE: *Use the automatic wetting routine!*

Last for approx. 1 minute!
Press "**BG-Electrode**".
Attach a syringe or a capillary filled with wetting agent to the fill port area and injects wetting agent until the glass tube is completely filled.
Follow the instructions on the screen.

CAUTION when handling blood! Biohazard!

ISE measuring chamber

It is expected that this cleaning procedure will depend on the typical sample type of a laboratory (e.g.: physiological, pathological, fetal blood).
An internal cleaning with Solution 6 will be performed automatically after every 1000 sample measurements.

Afterwards the measuring system must be conditioned with a wetting agent.

NOTE: *If the warning "**Cl Electrode Dirty (Defect)!**" appears, cleaning of the Cl^--Electrode is recommended (see also „Cleaning Instructions OMNI Cl^--Electrode“, AT0427 or chapter 9, “Troubleshooting”).*

Cleaning

Activate the function program "**System - Util - Analyzer Actions - Fluid Actions - Cleaning Routines**".
Activate the ISE module and press "**Start External Cleaning**".
The cleaning agent is introduced in the fill port like a sample (syringe or capillary).

Wetting

To wet the ISE module after the cleaning process, several measurements (2-3) with whole blood have to be performed.
If that is not possible or the cleaning procedure tripped an alarm for a complete module, activate "**System - Util - Analyzer Actions - Fluid Actions - Wetting Electrodes - ISE Electrodes - Automatic / manually**".

NOTE: *Use automatic mode exclusively!*

Last for approx. 1 minute!
Press "**ISE-Electrode**".
Attach a syringe or a capillary filled with blood to the fill port area and inject wetting agent until the glass tube is completely filled.
Follow the instructions on the screen.

CAUTION when handling blood! Biohazard!

MSS measuring chamber

Since the MSS cassette should not come in contact with cleaning solution (will cause damage of the sensor), use an MSS dummy cartridge for cleaning the MSS measuring chamber.
After completion of the cleaning procedure make sure to moisten the new MSS cassette with whole blood using the polarisation routine.

Do not use disinfectants containing alcohol for cleaning the inside of the **MSS measuring chamber cover**. Use e.g. AVL Deproteinizer.

Use this cleaning procedure after each exchange MSS cassette but not often than once a month.

Procedure

1. Remove the MSS cassette from the module.
2. Insert the MSS dummy cassette.
3. Activate the function program "**Options - Cleaning - Module Cleaning**".
4. Select the MSS module.
5. Press: "**Start External Cleaning**".
6. Introduce the external cleaning solution via the fill port in the same way a sample is introduced (syringe or capillary).
7. An internal cleaning with Solution 6 will be performed automatically after every 1000 sample measurements.
8. Insert a new MSS cassette.

List of modifications, chapter 2 (Revisions)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Electronic	•, Δ	•, Δ	•	•	•	•	•
Software	•, Δ	•, Δ	•	Δ	Δ	Δ	Δ
Service Manual	•	•, Δ	•	•	•	•	•

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Electronic	•						
Software	Δ						
Service Manual	•						

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

2 REVISIONS

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2 Revisions

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_6G	**Mainboard**		I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_8D	**MC heat control**		
BB0532	Rev_11	**MC ceramic heater**		
BB0533	Rev_44	**Heat foil**		
BB0534	Rev_45	**MC cover heat control**		
BB0539	Rev_58	**Fluid level detector board**		
BB0548	Rev_5B	**T&D control**		I17: XP0079 CS: $EE78
BB0551	Rev_22	**tHb board**		
BB0555	Rev_68	**Motherboard**		
BB0582	Rev_45	**SD heat control**		
BB0584	Rev_02	**BFR board**		
BB0835	Rev_35	**Hemolyzer board**		I2:XP0263
BB0854	Rev_25	**Aktor Control**		I1:XP0223
BB0856	Rev_22	**Aktor Board 6XQK**		I1, 4, 6: XP0223
BB0857	Rev_33	**Aktor Board 14XPC**		I2, 4, 6, 9, 11, 13, 15: XP0223
BB0987	Rev_22	**Aktor Board V23**		I2: XP0223
BB0988	Rev_22	**Aktor Board V24/V02**		I2: XP0223
BB0986	Rev_22	**Aktor Board V19**		I2: XP0223
BB0984	Rev_22	**Aktor Board V04/V03**		I2: XP0223
BB0985	Rev_22	**Aktor Board V13**		I2: XP0223
BB0651	Rev_11	**T&D sensor board**		
BB0657	Rev_02	**Sensorprint-Waste**		
BB0663	Rev_13	**PolyOx-KX-Control**		I21 XP0139 CS: $CC93 I22 XZ0109 (3.04) CS: $73B6
BB0662	Rev_00	**PolyOx-Digital**		I5 XP0138 CS: $82B3 V3.04
BB0661	Rev_03	**PolyOx-Analog**		
BB0725	Rev_00	**PolyOx-Heat**		
EN0309	Rev_3.ß	**A007 (B486SLC), AT96**	SN > 1500	
EN0329	Rev_7.5	**AVLIFB (AT96)**	SN > 2566	
BB0722	Rev_22	**Display IFR**	SN > 1500	
BB0808	Rev_00	**IFR connector board**	SN > 2800	
EL0281	Rev_00	**TFT LCD converter**	SN > 2800	

EN0292	Rev_02	**Power supply unit**		
BB0739	Rev_22	**SSE (MSS) Amp Glu/Lac**		
BB0741	Rev_47	**SSE (MSS)-Mainboard**		
ZM0845	Rev_33	**SSE (MSS) flexprint**		
ZM0804	Rev_33	**SSE (MSS) connector board**		
BB0774	Rev_01	**SSE (MSS) contact print**		

AutoQC (Option)

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BB0760	Rev_13	**AQC control board**		I13: XP0177 CS: $2565 I23: XZ0145 CS: $65E0
BB0771	Rev_00	**YZ-distributor board**		
BB0772	Rev_02	**Z-distributor board**		

Software

Software version 1.xxx

AVL OMNI™ 1, 2, 4 and 5 (International)

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
05.09.1995	1.00	1.600	2.470	2.450	-	First release	≥1000
12.10.1995	1.01	1.800	2.476	2.455	-		≥1175
19.12.1995	1.02	1.900	2.479	2.457	-		≈1150
12.02.1996	1.05	1.902	2.484	2.460	-	Deproteinizing MC cartridge	≥1500

AVL OMNI™ 3 and 6 (International)

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
17.01.1996	1.50	1.930	2.600	2.500	1.900	First release	≥1500
20.02.1996	1.60	1.937	2.609	2.501	1.904		≥1512
25.03.1996	1.64	1.942	2.616	2.501	1.907		≥1518

AVL OMNI™ 1, 2, 4 and 5 (USA)

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
05.09.1995	1.00	1.600	2.470	2.450	-	First release	≥1000
12.10.1995	1.01	1.800	2.476	2.455	-		≥1175
19.12.1995	1.02	1.900	2.479	2.457	-		≈1150
19.12.1995	1.03	1.901	2.479	2.457	-	USA version (Hct)	≈1150
25.12.1995	1.04	1.901	2.479	2.458	-	USA version (stddev x2)	≈1150
12.02.1996	1.06	1.903	2.484	2.460	-	Deproteinizing MC cartridge	≥1500

AVL OMNI™ 3 and 6 (USA)

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
29.01.1996	1.51	1.933	2.603	2.500	1.903	First release	≥1500
20.02.1996	1.61	1.938	2.609	2.501	1.904		≥1512
25.03.1996	1.65	1.943	2.616	2.501	3.001		≥1518

Software version 2.xxx

The software versions from AVL OMNI™ 1, 2, 4, 5 and 3, 6 and 9 have been collected from version ≥ 2.0 on.

AVL OMNI™ 1 to 9

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
17.09.1996	2.04	2.099	2.650	2.566	1.938	First release	≈2155
30.09.1996	2.05	2.099	2.653	2.566	1.938		≥2081
15.10.1996	2.06	2.099	2.656	2.566	1.938		OMNI 1: ≥2117 OMNI 2: ≥2197 OMNI 3: ≥2084 OMNI 4: ≥2162 OMNI 5: ≥2125 OMNI 6: ≥2166
27.01.1997	3.05	3.036	3.107	3.080	3.018		OMNI 1: ≥2370 OMNI 2: ≥2323 OMNI 3: ≥2415 OMNI 4: ≥2390 OMNI 5: ≥2434 OMNI 6: ≥2403
24.03.1997	3.10	3.504	3.112	3.080	3.018		OMNI 1: ≥2411 OMNI 2: ≥2446 OMNI 3: ≥2455 OMNI 4: ≥2429 OMNI 5: ≥2471 OMNI 6: ≥2459
12.05.1997	3.31	3.048	3.569	3.547	3.055		OMNI 1: ≥2408 OMNI 2: ≥2445 OMNI 3: ≥2462 OMNI 4: ≥2489 OMNI 5: ≥2527 OMNI 6: ≥2536
02.06.1997	3.32	3.048	3.569	3.548	3.055		OMNI 1: ≥2411 OMNI 2: ≥2446 OMNI 3: ≥2455 OMNI 4: ≥2490 OMNI 5: ≥2532 OMNI 6: ≥2523
18.08.1997	4.04	4.041	4.094	4.065	4.003	Release for AVL OMNI™ 7 to 9 only	OMNI 7: ≥2651 OMNI 8: ≥2692 OMNI 9: ≥2682

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
18.11.1997	4.12	4.110	4.117	4.084	4.003		OMNI 1: ≥3069 OMNI 2: ≥2762 OMNI 3: ≥3035 OMNI 4: ≥3120 OMNI 5: ≥3015 OMNI 6: ≥3008 OMNI 7: ≥3111 OMNI 8: ≥3010 OMNI 9: ≥3063
20.04.1998	4.50	4.215	5.061	5.044	4.010		OMNI 1: ≥3340 OMNI 2: ≥3209 OMNI 3: ≥3349 OMNI 4: ≥3340 OMNI 5: ≥3344 OMNI 6: ≥3352 OMNI 7: ≥3322 OMNI 8: ≥3324 OMNI 9: ≥3315
19.05.1998	4.51	4.218	5.061	5.044	4.010		OMNI 1: ≥3403 OMNI 2: ≥3399 OMNI 3: ≥3377 OMNI 4: ≥3405 OMNI 5: ≥3401 OMNI 6: ≥3390 OMNI 7: ≥3321 OMNI 8: ≥3382 OMNI 9: ≥3388
18.11.1998	5.02	4.322	5.517	5.594	5.023		OMNI 1: ≥5000 OMNI 2: ≥5000 OMNI 3: ≥5000 OMNI 4: ≥5000 OMNI 5: ≥5000 OMNI 6: ≥5000 OMNI 7: ≥5000 OMNI 8: ≥5000 OMNI 9: ≥5000
22.03.1999	5.10	4.330	5.531	5.602	5.024		OMNI 1: ≥5270 OMNI 2: ≥5172 OMNI 3: ≥5256 OMNI 4: ≥5209 OMNI 5: ≥5259 OMNI 6: ≥5243 OMNI 7: ≥5232 OMNI 8: ≥5234 OMNI 9: ≥5239

Date of release	Superior version number	PC-version	HS-version	MM-version	COOX-version	Remark	SN
13.03.2000	5.50	5.520	5.541	5.610	5.025		OMNI 1: ≥5960 OMNI 2: ≥5961 OMNI 3: ≥5977 OMNI 4: ≥5966 OMNI 5: ≥5936 OMNI 6: ≥5991 OMNI 7: ≥5922 OMNI 8: ≥5925 OMNI 9: ≥5969

Service Manual

Edition May 2000, Rev. 9.0

List of modifications, chapter 3 (Description of functions / Specifications)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Application	Δ	•		•, Δ	•, Δ		Δ
Measurement parameters	Δ	•			Δ	Δ	Δ
Input values	Δ		Δ				Δ
Calculated parameters	•		Δ		Δ	Δ	Δ
Type of calibrations	Δ			•	•, Δ	•, Δ	•, Δ
Type of measurements	Δ			•	Δ		Δ
Sample dates	•, Δ				•, Δ	•, Δ	
Sample volumes	Δ	Δ			Δ	Δ	•, Δ
Type of antikoagulants				Δ			
Reagents		•	•	•, Δ	Δ	•	Δ
Measurement data							
Environmental considerations - Instrument					•, Δ	Δ	•
Environmental considerations - Electrodes					•, Δ	Δ	•
Environmental considerations - Reagents					•, Δ		•
Electrical requirements	Δ	•			Δ		
Data management	Δ	•, Δ					
Classification	•	Δ					
Dimension	Δ			Δ			
Weight	Δ			Δ	•		
Test certificates	•	Δ					
Acoustic noise level							•

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Application							
Measurement parameters	•, Δ						
Input values	•						
Calculated parameters							
Type of calibrations							
Type of measurements							
Sample dates							
Sample volumes							
Type of antikoagulants							
Reagents	Δ						
Measurement data							
Environmental considerations - Instrument							
Environmental considerations - Electrodes							
Environmental considerations - Reagents	Δ						
Electrical requirements	•						
Data management							
Classification							
Dimension							
Weight							
Test certificates							
Acoustic noise level							

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

3 DESCRIPTION OF FUNCTIONS / SPECIFICATIONS

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3 Description of functions / Specifications

Application

The AVL OMNI™ is a modular, fully automatic, multi-processor controlled "Critical Care Analyzer". It allows the measurement of blood gases, total hemoglobin, electrolytes, hematocrit and metabolite in whole blood, serum, plasma, dialysate and QC materials.
The analyzer allows a free selection of combinations of the offered parameters (Random-Access-Combination-System), by the user.

The system is available in the following configurations:

AVL OMNI™	Parameter
1	BG[1]
2	BG and tHb (*c*tHb)
3	BG and COOX[2]
4	BG, ISE[3] and Hct
5	BG, ISE, tHb and Hct
6	BG, ISE, COOX and Hct
7	BG, ISE, MSS[4] and Hct
8	BG, ISE, tHb, MSS and Hct
9	BG, ISE, COOX, MSS and Hct

A specific measurement module is necessary and responsible for each one or for more of the parameter groups to be measured.
These modules and their parameters e.g. functions are:

- Main control with measurement control module
- T&D module
- PC unit
- COOX module
- AutoQC module (optional)

[1] BG = (pH, PO_2 and PCO_2)
[2] COOX = (*c*tHb, O_2Hb, HHb, COHb, MetHb, SulfHb)
[3] ISE = (Na, K, Cl, iCa)
[4] MSS = (Glucose, Lactate, Urea/BUN)

Main control with measurement modules

The main control steers and checks the actual calibration and measurement functions of the AVL OMNI™. A measurement control module is connected to the main control which, depending upon the version of the analyzer, is connected to the following measuring chambers over the Motherboard:

- **BG measuring chamber:**
  Measurement of partial pressure PO_2, partial pressure PCO_2 and pH value.
- **ISE measuring chamber:**
  Measurement of ion concentrations of Na^+, K^+, Cl^-, iCa^{++} and Hct.
- **MSS measuring chamber:**
  Measurement of glucose, lactate and urea
- **tHb measuring chamber:**
  Measurement of total hemoglobin.
- **COOX module:**
  Measurement of the hemoglobin derivatives O_2Hb, HHb, COHb, MetHb, SulfHb, *c*tHb and SO_2.

The main control and measurement control module are located on a common board, called Mainboard. The individual measurement chambers are connected over the Motherboard. A detailed description of these modules can be found in chapter 5 "Function Modules from A - Z".

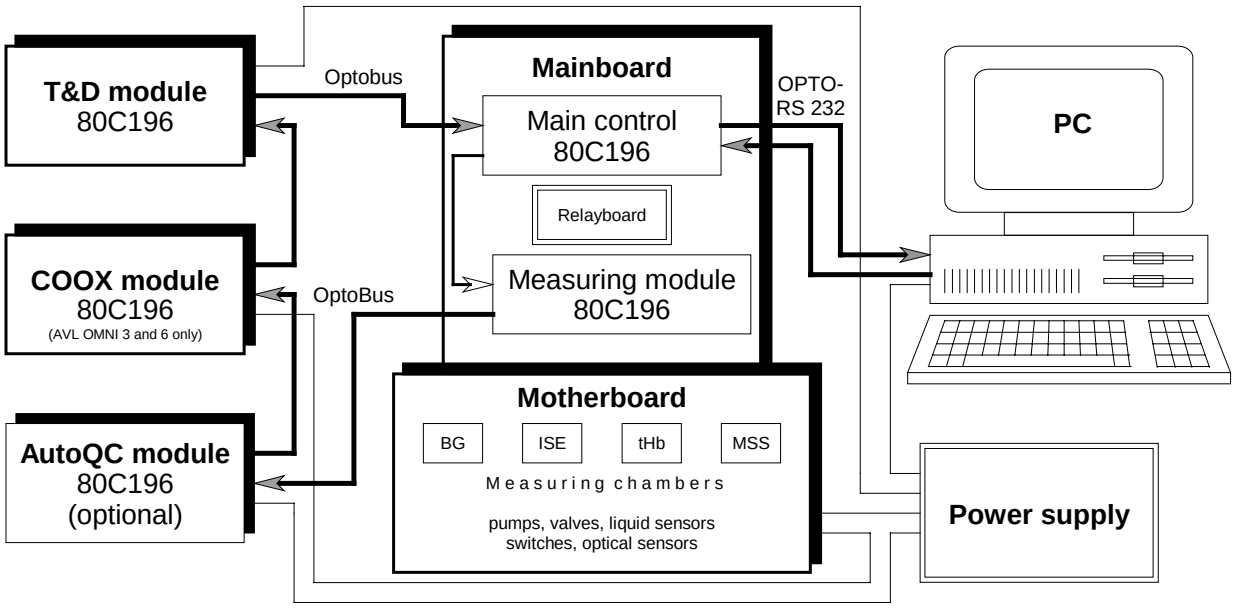


Fig. 1: AVL OMNI™ - Block diagram

T&D module

This module is necessary for sample input and the control of calibration fluids. A detailed description of this module can be found in Chapter 5 "Function Modules from A - Z".

PC unit

An in the AVL OMNI™ integrated PC with a color touch screen and built-in mass storage serves as a user interface. Further functions of this PC unit are the storage of patient data and other specific data pertaining to the analyzer, as well as the controlling of the built-in thermal printer and the use of interfaces. A detailed description of this module can be found in Chapter 5 "Function Modules from A - Z".

COOX module

Measurement of the hemoglobin derivatives O_2Hb, HHb, COHb, MetHb, SulfHb, *c*tHb and SO_2.
A detailed description of this module can be found in chapter 5 "Function Modules from A - Z".

AutoQC module (option)

The AutoQC module is an unit which, together with the AVL OMNI™, automatically performs quality control measurements at times preprogrammed by the user.

The cooperation between single modules

The main control is responsible for the functions of the analyzer and serves as a superior position or "Master" for all other AVL OMNI™ modules. The user functions or user surface, data storage and interface control are checked by the PC. The main control and the PC communicate by means of a serial RS 232 interface, which is designed as an optical interface and is connected at the PC with the COM1.
The communication from the main control to the specific modules is established by a serial optical ringbus, the so-called Optobus. Only the part of the ringbus from the main control to the measurement control module is an electrical connection, since both modules are located on a printed circuit board. Each module has an address and can be reached by the main control or by another module. The main control can give the transmitting rights to the specific, single modules. The main control and the measurement control module to a certain extent, steers and checks the pumps and valves, as well as the optical sensors for the aspiration process and controls the fill levels in the reagent bottles. The measurement module is responsible for recording data resulting from sensor signals from the specific measuring chambers, as well as for temperature control.
The following brief examples describe the distribution of functions and the respective communication of each module or PC:

- User inserts capillary for measurement: The T&D module recognizes the inserted capillary and sends the corresponding information to the main control on the Optobus. The main control transmits this to the PC by means of the optical serial interface, causing a change of display The PC initiates the further functions at the main control which are necessary for measurement.
- A user would like to perform a T&D test and calls up this function on the display: The PC sends the appropriate message to the main control, which identifies it as a so-called macro command which is intended for the T&D module, and sends the information further to the Optobus. In this case, the T&D module performs the test and transmits the o.k. or the error report in the same manner.

One exception pertaining to the flow of communication exists at the main control and measurement control module concerning the valve gear. Both controls have their own control circuit for the valves and a so-called "wired or circuit" which allows the turning on with both controls when necessary for reasons of speed. It is to be noted, that the valve gear for the valve test is only performed by the main control.

The communication on the optical ringbus (Optobus) allows an automatic hardware echo, which means that the transmitted information will be received, after running through the loop, where it is checked for correctness. At the same time, an interruption will be recognized immediately.

With the help of the software-handshake and checksum, the communication between the PC and the main control is checked for correctness during transmission. In addition, the connection is continuously controlled.
The PC gives the superior functions and the main control the specific commands, in accordance to the work cycles, further to the modules. Therefore, the measurement module for example, gives pre-calculated voltage values during measurement, the PC calculates the respective measurement values based on the previously determined calibration values and existing correction values.

AVL OMNI™ - Wiring and wiring without PC

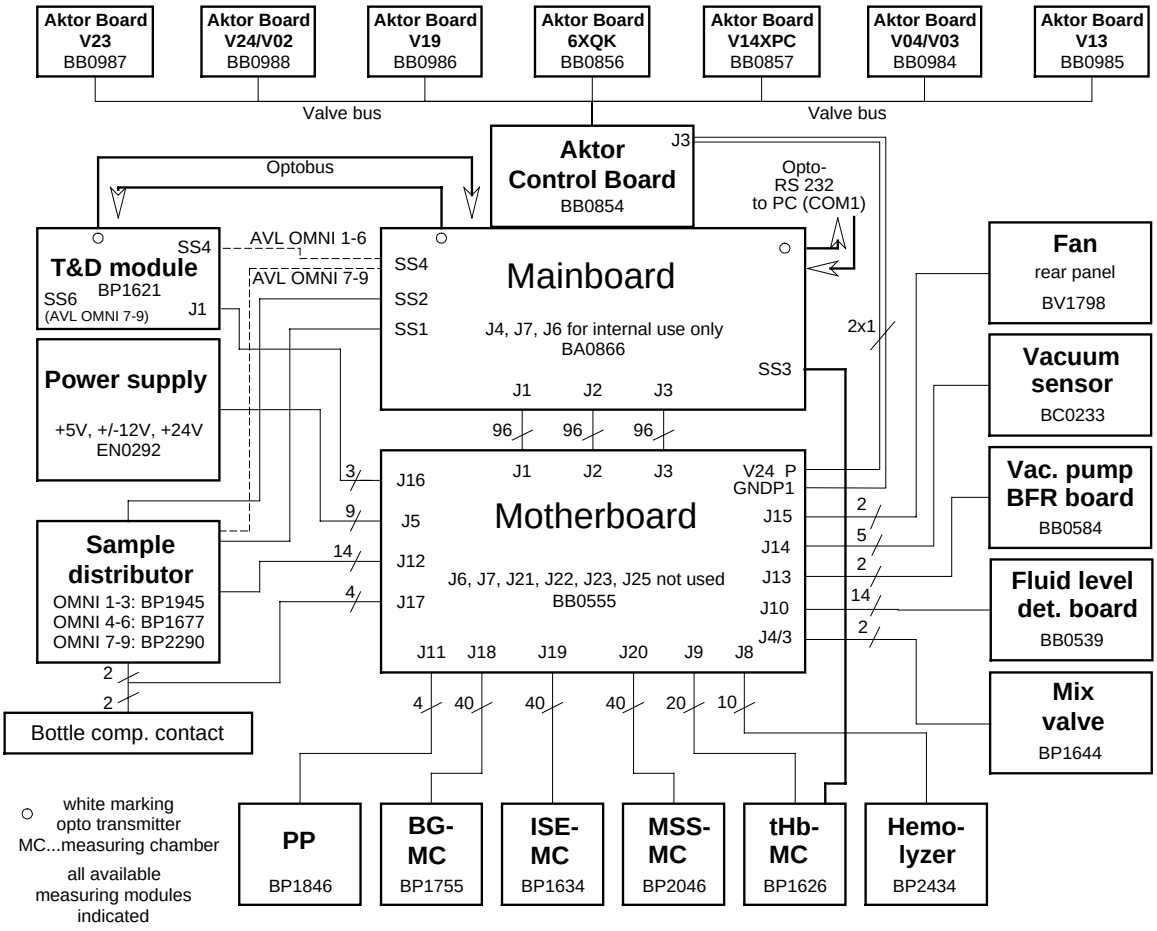


Fig. 2: AVL OMNI™ - Internal wiring

The wiring of the PC tower with the power supply unit is shown on a separate circuit diagram. These circuit diagrams and more detailed information about the modules can be found in chapter 5, "Function Modules from A - Z".

The central wiring element of the analyzer is the Motherboard.

The Mainboard, with both of the functional units main control with measurement modules is directly connected to the Motherboard with the connector (J1, J2, J3). Only the photoconductor connection for the Optobus and to the optical RS 232 interface of the PC, and photoconductor connection to the optical sensors SS1 to SS4 (SS6 at AVL OMNI™ 7, 8 and 9) are directly connected to the Mainboard. The transmitter plugs are either white or marked with white at the optical data connections.
Peristaltic pump (PP): The stepper motor of the pump is directly connected to the Motherboard at J11. The control for the stepper motor is located on the Mainboard.

The vacuum pump is connected at J13. The pre-switched BFR board suppresses disturbances, which can be caused by the vacuum pump direct-current motor.
The fan is located on the rear of the analyzer and the corresponding plug on the Motherboard is J15. A further fan is located in the PC tower.
The vacuum sensor for the under pressure control of the wash cycles is connected at J14 on the Motherboard.
The control switch for the cover of the bottle compartment is connected at J17 of the Motherboard with a small laced wiring harness also leading to the contact of the sample distributor.

Detailed information pertaining to the components mentioned above, can be found in chapter 5, "Function Modules from A - Z".

Measurement parameters [5]

Parameter	Unit	Displayed range	Resolution	Specified range	Used sample type	Precision *)
Blood gas module						
PO_2	mmHg	0 to 800	0.1	60 to 140	T	SD < 1.2
PCO_2	mmHg	4 to 200	0.1	15 to 70	T	SD < 1.0
pH		6.0 to 8.0	0.001	6.8 to 7.6	T, Q	SD < 0.005
					S	SD < 0.012
Baro	mmHg	300 to 800	0.1	550 to 800	air pressure	typ. ± 2
Electrolyte module						
Na	mmol/L	20 to 250	0.1	120 to 170	T, S, A, Q	SD < 1.5
K	mmol/L	0.2 to 20	0.01	3.0 to 6.0	T, S, A, Q	SD < 0.05
Cl	mmol/L	20 to 250	0.1	70 to 130	T, S, A, Q	SD < 1.0
Ca	mmol/L	0.1 to 6.0	0.001	0.6 to 1.5	T, S, A, Q	SD < 0.03
Hct	%	10 to 80	0.1	20 to 60	T	not specif.
Haemoglobin module						
***c*tHb**	g/dL	3 to 24	0.1	3 to 24	T	SD < 0.2
CO-oximetry module						
O_2Hb	%	0.0 to 100.0	0.1	0.0 to 100.0	T	SD < 1.2
HHb	%	0.0 to 100.0	0.1	0.0 to 100.0	T	SD < 1.2
COHb	%	0.0 to 100.0	0.1	0.0 to 100.0	T	SD < 0.3
MetHb	%	0.0 to 100.0	0.1	0.0 to 20.0	T	SD < 0.2
SulfHb	%	0.0 to 100.0	0.1	not specif.	T	not specif.
Metabolite module						
Glu	mmol/L	0.5 to 40	0.1	1 to 10	T, S, Q	SD < 0.1 or CV < 3%
Lac	mmol/L	0.2 to 20	0.1	0.5 to 5	T, S, Q	SD < 0.1 or CV < 3%
Urea	mmol/L	0.5 to 40	0.1	2 to 10	T, S, Q	SD < 0.1 or CV < 3%
BUN	mg/dL	1.4 to 112	0.1	5.6 to 28.0	T, S, Q	SD < 0.3 or CV < 3 %

*) 20 days" within run precision" after NCCLS

Specified for:

T ..... tonometered blood Q.....aqueous QC material A .....Acetate S .....Serum or Plasma

[5] The instrument is designed for the measurement of parameters in whole blood and serum and the accuracy of these measurement values is tested.
The accuracy of measurement values in aqueous AVL Control is ensured through appropriate composition of the solutions as well as appropriate corrective measures in the QC program (if needed) regarding the differences between these controls and biological sample material.
The accuracy of measurement values in other aqueous solutions cannot be ensured (e.g. due to unknown interference's, and/or missing or insufficient buffer systems, and/or differences in ionic strength and diffusion potential compared to biological sample material).

Input values

- Patient code
- Last name
- First name
- Middle initial
- Insurance Number
- Sample type
- Sex
- Date of birth
- Blood type
- Puncture site
- User
- Technician
- Physician
- Accepted
- ALLEN test
- Time of collection
- Date of collection
- Transfer time:
- Transfer date:
- Comments
- Accession Code
- Department
- Location
- TVOL *)
- MVOL *)
- Vent. Modus *)
- PIP *)
- LPM *)
- ITIME *)
- ETIME *)
- SRATE *)
- ARATE *)
- PEEP *)
- Glu
- Lac
- BUN
- Temp
- a/f
- R
- FIO_2
- P_{50} **)
- ctHb (E) ***)
- + 2 free definable customer lines

*) so called "respiration dates", only used when the patient is connected to a respirator.

**) Only at AVL OMNI™ 3, 6 and 9 a calculated parameter!

***) tHb replacement value, if tHb could not be measured!

****) Only at AVL OMNI™ 1 to 6 an input value!

All suitable input parameters (e.g.: patient ID, operator ID) can also be entered with the aid of the barcode scanner.

Calculated parameters[6]

		Range
pH at patient temperature	pH^t	6 8
Standard pH value	pH_{st}	6.5 ..... 8.5
PCO_2 at patient temperature	*P*CO_2^t	0 ..... 200 mmHg
PO_2 at patient temperature	*P*O_2^t	0 ..... 742 mmHg
Hydrogen ion concentration	*c*H^+	10 ..... 1000 nmol/l
Hydrogen ion concentration at patient temperature	*c*H^t	10 ..... 1000 nmol/l
Bicarbonate concentration	*c*HCO_3^-	1 ..... 100 mmol/l
Standard bicarbonate	*c*$HCO_3^-{}_{st}$	1 ..... 100 mmol/l
Total CO_2 concentration in plasma	*c*t$CO_{2(P)}$	1 ..... 100 mmol/l
Total CO_2 concentration in blood	*c*t$CO_{2(B)}$	1 ..... 100 mmol/l
Functional (available) oxygen saturation	*S*O_2	0 ..... 100 %
Functional oxygen saturation (uses blood gas values)	*S*$O_{2(c)}$	0 ..... 100 %
Fractional oxygen saturation	*F*O_2Hb	0 ..... 100 %
Base excess in blood	BE	-40 ..... +40 mmol/l
Base excess in vivo	BE_{ecf}	-40 ..... +40 mmol/l
Buffer bases	BB	0 ..... 100 mmol/l
Oxygen concentration (arterial) (*P*O_2, *S*O_2, COHb, MetHb, *c*tHb)	*c*tO_2	0 ..... 56 vol%
Half Saturation Tension of Oxygen in Partial Pressure of Oxygen	P_{50} *)	0 ..... 100 mmHg
Alveolar arterial oxygen partial pressure	*P*AO_2	40 ..... 730 mmHg
Alveolar arterial oxygen partial pressure at patient temperature	*P*AO_2^t	40 ..... 730 mmHg
Alveolar arterial oxygen partial pressure difference	$AaDO_2$	0 742
Alveolar arterial oxygen partial pressure difference at patient temperature	$AaDO_2^t$	
Arterial-venous oxygen content difference	$avDO_2$	
Alveolar arterial oxygen partial pressure ratio	a/AO_2	
Alveolar arterial oxygen partial pressure at patient temperature	a/AO_2^t	
Respiratory index	RI	0.7 ..... 0.9
Respiratory index at patient temperature	RI^t	0.7 ..... 0.9
Shunt	Os/Ot	
Standardized ionized calcium	$niCa^{++}$ (pH=7.4)	0.1 ..... 6.0 mmol/l
Anion gap	AG	3 ..... 30 mmol/l
Mean corpuscular hemoglobin concentration	MCHC	
Hct as a function of tHb	Hct(c)	
Oxygen capacity (only COOX)	BO_2	
BE at actual oxygen saturation	BE (act)	
Hb-Indicator	HbI **)	
Osmolality	Osm ***)	
Oxygen Extraction Ratio	OER	
Blood Urea Nitrogen	BUN	

*) Only at AVL OMNI™ 3, 6 and 9 a calculated parameter!
**) Only displayed, if tHb is not measured
***) Only in the versions of AVL OMNI™ 7 – 9
****) Only in the versions of AVL OMNI™ 7 – 9 with Urea

[6] Displayed calculated values are not limited!

Type of calibrations

	Frequency	Duration [min] AVL OMNI™		
		1-5/6	**7-8/9**	**7-8/9**[7]
System calibration	every 24 hours (setup 12 or 24 hours)	11/12.5	16.6/18.4	18.4/19.9
2P calibration	every 12 hours (setup 4, 6, 8, 10, 12 hours)	7	12.6	14.4
1P calibration	every 0.5 hours or every hour	1.5	3.3	4.3
1P calibration after every sample	in measurement included			
tHb calibration	every 100 days, (manual)	3	3	3
Warm-up	on demand	10	10	10
Electrode change	on demand	19	19	19
MSS cassette change	on demand	60	60	60
COOX cal	during system calibration	1.5	1.5	1.5
1P MSS calibration	Every 15 minutes within the first 4 hours after an MSS polarization.	-	1.8	2.8
2P MSS calibration	Every 2 hours within the first 5 hours after an MSS polarization, thereafter at selected intervals. For urea: every 4 hours between 5 and 24 hours, thereafter at default intervals.	-	5.6	7.4

Type of measurements

pH, PCO_2, Urea	potentiometric
PO_2	amperometric
Na, K, Cl, Ca	direct potentiometric
tHb	photometric
Hct	conductance
COOX	photometric
Glu, Lac	amperometric

[7] Valid with MSS with Urea (BUN) only!

Sample dates / calibration times

Activated / Installed modules	Optimal sample rate [sample/hours]		Typical calibration times [min]		
	Syringe	Capillary	Sys. cal	2P cal.	1P cal.
BG	40	36	11	7	1.5[8]
BG-tHb	36	32	11	7	1.5[6]
BG-COOX	36	32	12.5	7	1.5[6]
BG-ISE	40	36	11	7	1.5[6]
BG-ISE-tHb	35	32	11	7	1.5[6]
BG-ISE-COOX	35	32	12.5	7	1.5[6]
ISE-tHb	39	34	11	7	1.5[6]
ISE-COOX	39	34	12.5	7	1.5[6]
tHb	40	35			
COOX	40	35			
ISE	42	38	11	7	1,5[6]
MSS-(Urea)	32 (30)	28 (26)	5.6 (7.4)	5.6 (7.4)	1.8 (2.8)9
BG-MSS-(Urea)	30 (29)	27 (26)	16.6 (18.4)	12.6 (14.9)	3.3 (4.3)10
BG-ISE-MSS-(Urea)	30 (29)	26 (26)	16.6 (18.4)	12.6 (14.9)	3.3 (4.3)[8]
ISE-MSS-(Urea)	32 (30)	28 (26)	16.6 (18.4)	12.6 (14.9)	3.3 (4.3)[8]
tHb-MSS-(Urea)	31 (31)	27 (27)	5.6 (7.4)	5.6 (7.4)	1.8 (2.8)[7]
BG-ISE-MSS-(Urea)-tHb	29 (28)	25 (24)	16.6 (18.4)	12.6 (14.4)	3.3 (4.3)[8]
BG-ISE-MSS-(Urea)-COOX	28 (27)	25 (23)	18.1 (19.9)	12.6 (14.4)	3.3 (4.3)[8]

[8] if calibration interval is one hour, typ. calibration time: +0.5 min
9 if calibration interval is one hour, typ. calibration time: +0.9 min
10 if calibration interval is one hour, typ. calibration time: +1.4 min

Sample volumes

Activated / installed modules	Typical sample volumes*) [µl]	Typical sample volumes**) [µl]	Volume limitation by sample sensor [µl]
BG	40	46	65
BG-tHb	80	84	100
BG-COOX	80	84	100
BG-ISE	70	76	86
BG-ISE-tHb	110	115	140
BG-ISE-COOX	110	115	140
BG-ISE-MSS	121	129	200
BG-ISE-MSS-tHb	161	169	200
BG-ISE-MSS-COOX	161	169	200

***)** typical for Hct < 40%

****)** typical for 40% < Hct < 75%

Type of anticoagulants

Lithium heparin or balanced heparin mixtures (as often used for samples taken also for electrolyte analysis) are the only acceptable anticoagulants for blood gas, ISE and MSS analysis. Other anticoagulants such as EDTA, citrate, oxalate, fluoride and ammonium containing anticoagulants have a significant effect on blood pH and should not be used.

Reagents

Solution A	Order number:	**BP 1893**
	Use:	Rinse solution for sample path.
	Contents:	1 package contains 6 ready to use containers with 820 ml each.
	Solvent:	Water
	Active ingredients:	aqueous solution, Tensides
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution B	Order number:	**BP 1892**
	Use:	Solution for calibration of Na^+, K^+, iCa^{++}, Cl^-, pH and PCO_2 after controlled mixing with Solution B and C.
	Contents:	1 package contains 6 ready to use containers with 820 ml each.
	Solvent:	Water
	Active ingredients:	Electrolytes, carbonate, bicarbonate
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution C	Order number:	**BP 1891**
	Use:	Solution for calibration of Na^+, K^+, iCa^{++}, Cl^-, pH and PCO_2 after controlled mixing with Solution B and C.
	Contents:	1 package contains 6 ready to use containers with 480 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte and basic buffer components
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution D (GLU/LAC)	Order number:	**BP 2279**
	Use:	Standby- and rinse solution for metabolite sensors (glucose and lactate only)
	Contents:	1 package contains 6 ready to use containers with 480 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte and buffer components
	Storage temp.:	2 - 25 °C
	Stability:	Expiration date & lot number are printed on each container label.

Solution D (GLU/LAC/UREA)	Order number:	**BP 2191**
	Use:	Standby- and rinse solution for metabolite sensors (glucose, lactate and urea)
	Contents:	1 package contains 6 ready to use containers with 480 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte and buffer components, urea, ammonium
	Storage temp.:	2 - 25 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution R	Order number:	**BP 1894**
	Use:	Reference electrolyte solution for calibration pH-, ISE- and urea- electrodes.
	Contents:	1 package contains 12 ready to use containers with 100 ml each.
	Solvent:	Water
	Active ingredients:	Potassium Chloride, 1.2 mol /l
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 1 (GLU/LAC)	Order number:	**BP 2248**
	Use:	Solution for calibration of glucose and lactate.
	Contents:	1 package contains 4 ready to use containers with 40 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte, buffer components 4-Acetamidophenol
	Storage temp.:	2 - 25 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 1 (GLU/LAC/UREA)	Order number:	**BP 2292**
	Use:	Solution for calibration of glucose, lactate and urea.
	Contents:	1 package contains 4 ready to use containers with 38 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte, buffer components 4-Acetamidophenol, urea, ammonium
	Storage temp.:	2 - 8 °C
	Stability:	Expiration date & lot number are printed on each container label.

Solution 2	Order number:	**BP 1898**
	Use:	Solution for conditioning the Na^+-Electrode.
	Contents:	1 package contains 4 ready to use containers with 40 ml each.
	Solvent:	Water
	Active ingredients:	Ammonium hydrogen difluorid, 100 mmol/l
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 3 (GLU/LAC)	Order number:	**BP 2249**
	Use:	Solution for calibration of glucose and lactate.
	Contents:	1 package contains 4 ready to use containers with 40 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte, buffer components, glucose, lactate
	Storage temp.:	2 - 25 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 3 (GLU/LAC/UREA)	Order number:	**BP 2193**
	Use:	Solution for calibration of glucose, lactate and urea.
	Contents:	1 package contains 4 ready to use containers with 38 ml each.
	Solvent:	Water
	Active ingredients:	Electrolyte, buffer components, glucose, lactate, urea, ammonium
	Storage temp.:	2 - 8 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 4	Order number:	**BP 2068**
	Use:	Solution for calibration of PO_2-zero point.
	Contents:	1 package contains 4 ready to use containers with 40 ml each.
	Solvent:	Water
	Active ingredients:	Sodium sulfite and sodium hydrogen sulfite, total 600 mmol/l
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.

Solution 5 (GLU/LAC)	Order number:	**BP 2278**
	Use:	Solution for calibration of glucose and lactate.
	Contents:	1 package contains 6 ready to use container with 100 ml each
	Solvent:	Water
	Active ingredients:	Electrolyte, buffer components, glucose, lactate
	Storage temp.:	2 - 25 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 5 (GLU/LAC/UREA)	Order number:	**BP 2194**
	Use:	Solution for calibration of glucose, lactate and urea.
	Contents:	1 package contains 6 ready to use container with 98 ml each
	Solvent:	Water
	Active ingredients:	Electrolyte, buffer components, glucose, lactate, urea, ammonium
	Storage temp.:	2 - 25 °C
	Stability:	Expiration date & lot number are printed on each container label.
Solution 6	Order number:	**BP 2562**
	Use:	Cleaning solution for BG/ISE electrodes and COOX/MSS module (not for MSS cassettes).
	Contents:	1 package contains 2 ready to use container with 23 ml each
	Solvent:	Water
	Active ingredients:	Sodiumhypochlorite: < 1% active chlorine, Neodisher MA: 0.35%
	Storage temp.:	2 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.
AVL Deproteinizer	Order number:	**BP 0521**
	Use:	Cleaning solution for sample path
	Contents:	1 package contains 1 ready to use container with 125 ml
	Solvent:	Water
	Active ingredients:	Sodiumhypochlorite, < 2% active chlorine
	Storage temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each container label.

Hb Calibrator	Order Number:	**BP 1360**
	Use:	Solution for calibration of tHb
	Contents:	1 package contains 5 ampoules with 2 ml each.
	Solvent:	Water
	Active Ingredients:	Potassiumdihydrogenphosphate, Disodium-hydrogenphosphate, Amaranth, Tensides
	Storage Temp.:	15 - 30 °C
	Stability:	Expiration date & lot number are printed on each ampoule label

NOTE: *Use of calibration solutions or electrodes not manufactured for AVL could void the warranty.*
A Waste container is provided, once used, the Waste container holds biological fluids which may be potentially infectious; handle with appropriate care to avoid skin contact or ingestion. ***FOR IN-VITRO DIAGNOSTIC USE.***

Measurement data

Units ..... SI, conv.

Environmental considerations – Instrument

Operating conditions:

Temperature ..... +15 °C to +31 °C(59 °F to 87,8 °F)
Humidity ..... **AVL OMNI™ 1 - 6**, 20 to 95 %

AVL OMNI™ 7, 8, 9 (measuring chamber temperature adjustable):
up to 70 %, if temp. < 31 °C, (MC Temp. 25 °C)
up to 83 %, if temp. < 28 °C, (MC Temp. 25 °C)
up to 90 %, if temp. < 27 °C, (MC Temp. 25 °C)
up to 95 %, if temp. < 31 °C, (MC Temp. 30 °C)

Measuring chamber temperature:

BG & ISE ..... 37 °C ± 0.2 °C (98.6 °F ± 32.36 °F)
MSS ..... 25 °C ± 0.2 °C (77.0 °F ± 32.36 °F) or
30 °C ± 0.2 °C (86.0 °F ± 32.36 °F) adjustable
COOX ..... 37 °C ± 0.2 °C (98.6 °F ± 32.36 °F)
tHb..... 37 °C ± 0.5 °C (98.6 °F ± 32.9 °F)

Storage and transport conditions:

Temperature ..... - 20 °C to + 60 °C (-4 °F to + 140 °F)
Humidity ..... 0 - 95 % (non-condensing)
Shock resistance ..... < 50 g

Environmental considerations - Electrodes

Operating conditions:

Temperature	+37 °C (98.6 °F) for BG and ISE +25 °C (77.0 °F) or +30 °C (86.0 °F) for MSS
Humidity	20 to 85 %

Storage conditions in original packages:

Temperature	+15 °C to +30 °C (59.0 °F to 86.0 °F) for BG and ISE +2 °C to +8 °C (35.6 °F to 46.4 °F) for MSS
Humidity	20 to 80 %

Transport condition in original packages:

Temperature	-5 °C to +40 °C (23.0 °F to 104.0 °F), over a 3-day period -20 °C to +50 °C (-4.0 °F to 122.0 °F) for MSS, over a 3-day period
Humidity	0 - 80 %
Shock	< 50 g

Environmental considerations - Reagents

Operating conditions:

Temperature	+15 °C to +35 °C (59.0 °F to 95.0 °F)
Humidity	20 to 95 %

Storage conditions in original packages:

Temperature	see page 3-13
Humidity	20 to 95 %

Transport condition in original packages:

Temperature	**Solution A, B, C, R, 2, 4, 6:** -20 °C to +50 °C (-4.0 °F to 122.0 °F); max. 2 weeks **Solution 1, 3, 5 and 5:** -20 °C to +35 °C (-4.0 °F to 95.0 °F); max. 2 weeks
Air pressure	850 - 1050 mbar abs. (air cargo)
Shock	< 30 g

Electrical requirements

Voltage range	100 - 240 V AC (+6%/-10% permissible tolerance)
Frequency	50 - 60 Hz
Power consumption (max.)	250 VA (according to IEC 1010-1 (EN61010-1), the measured value is allowed to exceed 10% with consideration of all optional AVL accessory devices)
Fuse at device	2 x 2.5 AT

Data management

Integrated PC (5x86) with ≥ 500 MB hard disk (2.5“ or 3.5", floppy drive 3.5")	
Screen	color LCD (10") with touch screen handling
Thermal printer	capable for graphics, width of paper approx. 120 mm, paper length appr. 50 m / roll
Barcode scanner	standard
External keyboard	option
Interfaces	4 x RS 232, 1 x parallel, AUI Ethernet network

Classification

Safety category	I
Instrument type	B (ÖVE - MG/EN 60 601-1, IEC 601-1)
Operation type	For continuous operation
Protective system	IP20
Ex-protection	The device is not specified for operation inside explosion hazardous areas.

Dimensions

Width	55 cm	(21.67 Inch)
Depth	47 cm	(18.52 Inch)
Height	60 cm	(23.64 Inch), with touch screen open

AutoQC module (option):

Width	21 cm	(8.27 Inch)
Depth	38 cm	(14.00 Inch)
Height	15.6 cm	(6.15 Inch)

Weight

AVL OMNI™ 1 to 9	app. 33 kg	
AVL OMNI™ 1 to 9 ready for delivery	app. 44 kg	in carton, incl. Operator's Manual, accessories and cables
AutoQC module (option):	app. 4.5 kg	

Test certificates

ÖVE.....	tested according to the standard EN61010-1, as well as EN60601-1
CSA.....	tested according to the standard C22.2 No. 1010.1-92
CE-conformity.....	The analyzer corresponds to the directives 89/336/EEC (EMC-directives), tested according to the generic standard EN50081-1 and EN00081-2, as well as 73/23/EEC (Low Voltage Directive with addition 93/68/EWG), tested according to EN61010-1, and is allowed to be labeled with the CE-marking.

Acoustic noise level

in all modes..... max. 55 dB

List of modifications, chapter 4 (Installation / Shutdown)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug.. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Installation	•, Δ	•, Δ	•, Δ	Δ	•, Δ	•, Δ	•, Δ
Shutdown procedure	•, Δ		•	Δ	•		•, Δ
Installation of the AutoQC module (option)				Δ	•, Δ	Δ	•, Δ
Options						Δ	Δ

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Installation	Δ						
Shutdown procedure	Δ						
Installation of the AutoQC module (option)	Δ						
Options	Δ						

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

4 INSTALLATION / SHUTDOWN

Installation **4-1**

Shutdown procedure **4-11**
Less than 24 hours 4-11
More than 24 hours 4-11

Installation of the AutoQC module (option) **4-14**

Options **4-18**
Reusable Waste container 4-18
External Waste container 4-18
Barcode scanner 4-18
Keyboard 4-18
Paper take-up unit 4-18
MSS Conditioning System 4-18
AVL OMNILink™ 4-18

4 Installation / Shutdown

Installation

After the AVL OMNI™ has been set-up on a location where the requirements in chapter 1 are fulfilled, the following procedures must be done to achieve the ready status.

First check the analyzer and accessories for completeness and damage. The completeness can be checked by comparing with the delivery form. If something is missing, please notify your AVL representative.

If damage occurred, in spite of careful packaging, please inform the shipping agent promptly. Save the merchandise and the packaging material until the damage has been clarified.

***NOTE**:* *Dependent upon the country of destination, the accessories can differ slightly to those listed on the following pages.*
Ask your AVL representative for your specific accessory list.

Procedure

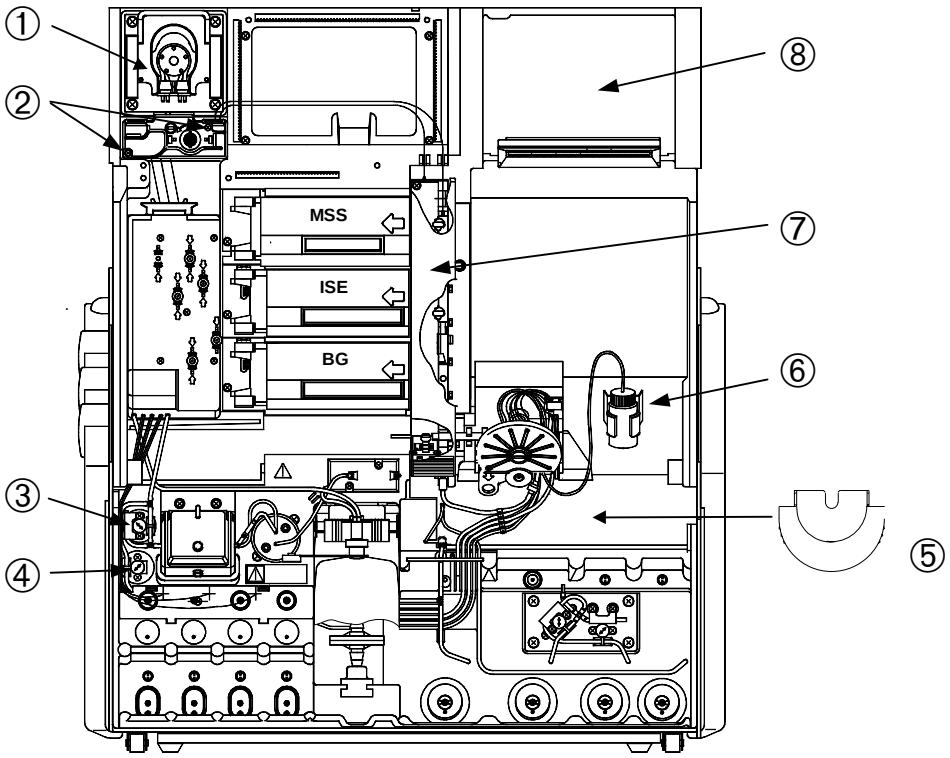


Fig. 1: Installation

1. Remove packaging (foam rubber, adhesive tape etc.).
2. Open the peristaltic pump cover.
3. Screw down the peristaltic pump cartridge ②.
4. Open the plexiglas cover (tension lever) of the peristaltic pump and push the linear clamp (white plastic part) ① in the direction of the arrow (see Fig. 1 and Fig. 2).
5. Place the tubing set (see accessory kit) around the roller (do not cross the tubes!).
6. Close the plexiglas cover (tension lever). The tubing holder is then pressed into the PP cartridge sealing part.

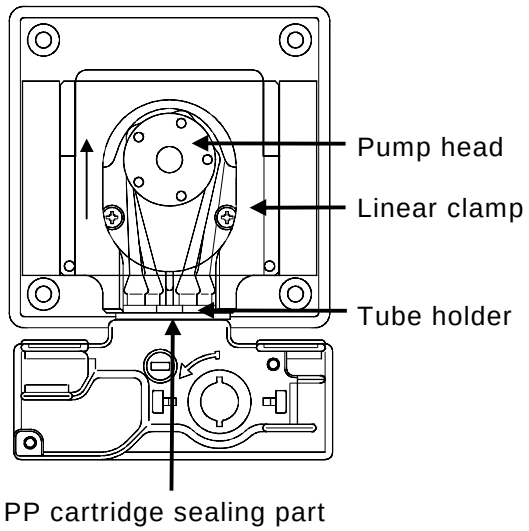


Fig. 2: Installation of PP tubing

7. Close the peristaltic pump cover.
8. Tip the screen in the upward direction.
9. Remove the analyzer cover , by lifting it on the left side (until the cover switch is released) and pulling it out toward the left.
10. *If your AVL OMNI™ includes an AutoQC module (option), install the AutoQC module first as described on page 4-14.*
11. (When re-installing a device with a serial number < 5000, remove the red relief clamp from valve V4 or mount on valve cap V4 [1] ③).
12. (When re-installing a device with a serial number < 5000, remove relief clamp ④ from valve V3.
13. Insert sample drip tray ⑤.
14. Remove foam rubber block from the sample distributor cartridge cover ⑦.
15. Secure the barcode holder and the barcode scanner as shown in Fig. 3.

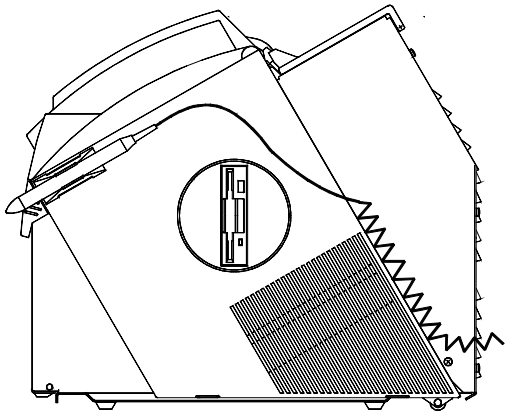


Fig. 3: Barcode holder

[1] Only if tHb- or COOX module is available (AVL OMNI™ 2, 3, 5, 6 and 9)

16. Connect the barcode scanner to the corresponding interface connector "**BARCODE**" on the rear panel of the AVL OMNI™.

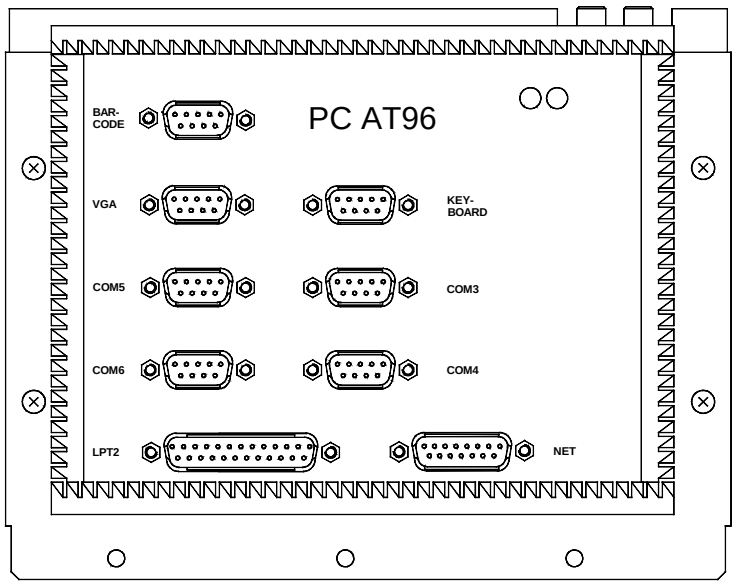


Fig. 4: Interface board

17. Connect the power cable and turn on the analyzer.
    The AVL OMNI™ performs a system start and a system check. After that, a warm-up phase of at least 10 minutes is initiated.
18. For use in non-English speaking countries, replace the English labels with the respective language labels included in the accessory box.
    At first start-up, the default language setting is English, which can be changed in the menu "**System - Setup - Miscellaneous - Language**".
19. During the warm-up phase insert the bottle compartment cover and press "**System - Util - Analyzer Actions - Assembling of FMS Tubes**".
    Follow the instructions on the screen and insert the supply tubes of bottles B and C in the clamps. Connect the supply tube to the container tube of bottle B (see Fig. 5).

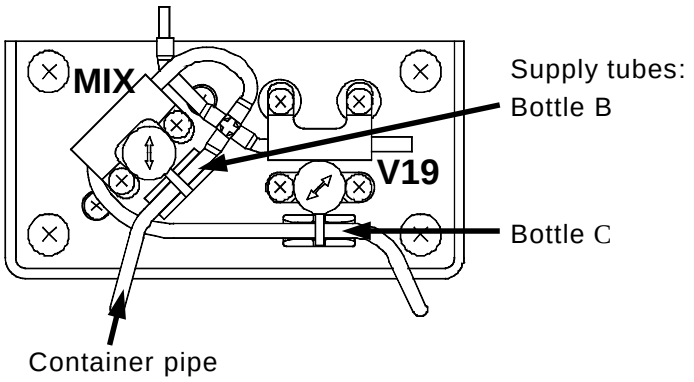


Fig. 5: FMS tubes

20. During first start-up, activate "**System - Util - Service Area - Activate Urea**", if the AVL OMNI™ is to be operated with the urea parameter. If not, continue with step 21.
    This function can be used to activate or deactivate the urea paramater after a reinitialization, if needed.
21. Insert reagent bottles and the Waste container.

    NOTE: *The ingredients for the solutions 1 (BP2248), 3 (BP2249), 5 (BP2278) and D (BP2279), designed for the measurement of glucose and lactate, would immediately cause damage to the urea sensor. Therefore another set of Solution 1 (BP2192), 3 (BP2193), 5 (BP2194) and D (BP2191) must be used.*

    Installing Solution 6:

    Place the screw cap on the bottle and insert it in the respective holder labelled "Cleaning Solution 6" (see Fig. 1, ⑥).
    Activate Solution 6 (internal Cleaning Solution) under "**System - Util - Service Area - Switches 2 - New Cleaning Sol.**".

    NOTE: *If the holder for Solution 6 is not there, please order Upgrade Kit for Solution 6 -* ***BP2565****.*

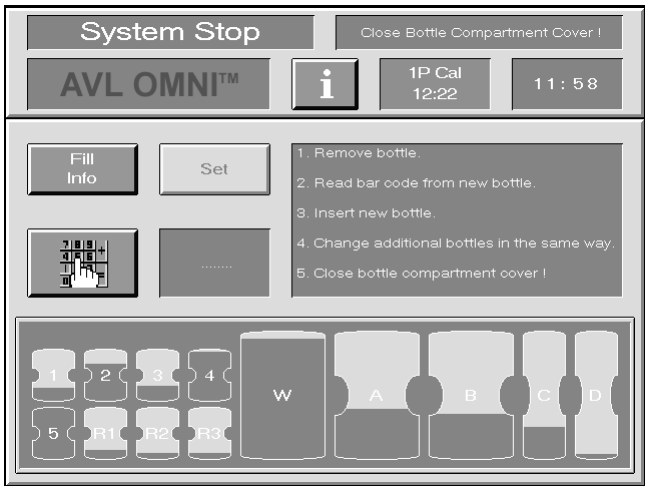


Fig. 6: Reagent bottles

22. Read in the barcode of the selected reagent. The AVL OMNI™ identifies the correct solution and checks the expiration date. The corresponding bottle symbol starts blinking on the screen. If the expiration date has been exceeded, a warning appears on the screen.
23. Press bottle firmly into position. The bottle symbol will stop blinking at Solution A, B, C, D, 5 and R.
    At the Solution 1, 2, 3 and 4 as well as at the Waste container the symbol will not stop blinking.
24. Insert all remaining bottles in the same manner.

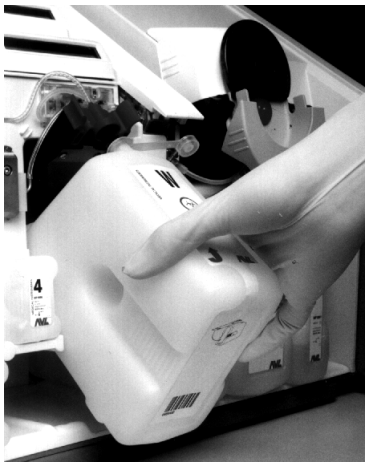


Fig. 7: Insert Waste container

NOTE: *During a new start-up procedure (only after correct shutdown procedure), the bottle is automatically set to "full", since the device cannot detect the actual fill level of the Waste container. If that is the case, the barcode of the container must be scanned again and the fill level must be entered.*

25. Remove the Waste container and scan the barcode from the Waste label. The symbol of the Waste container starts blinking on the screen.
26. Insert the bottle and press it down.

NOTE: *You have the possibility to insert bottles, which are already opened. In that case make sure that any spillage in the bottle compartment area is strictly avoided. Furthermore, consider that due to the storage of the reagent bottle with an open cap the chemical formulation might be changed and may cause problems. Therefore AVL does not recommend to use bottles which are already open.*

*Enter the filling level as accurately as possible, or the error message "**Check Fill Levels**" will appear, although the bottles are not empty. This applies only to bottles without fill level sensors (Solutions 1, 2, 3 and 4).*

27. After inserting the corresponding bottle, press the key "**Set**".
28. Enter the corresponding fill level in % (a scaling on the bottle label gives an approximate value).
29. Press the key "**Enter**". The screen shows the fill level entered.
30. Close the bottle compartment cover.
    The AVL OMNI™ starts a vacuum test.

NOTE: *Do not tilt the AVL OMNI™ with bottles inserted.*

31. Open the cover of the measuring chamber module by pushing the right side of the cover to the left with your finger and then pulling it up.

Fig. 8: Insert electrodes

32. Open the locking lever.
33. Insert the electrodes from left to right according to the color code:
    BG module: Ref, Jun, pH, *P*O_2, *P*CO_2
    ISE module: Ref, Jun, Na, K, Cl, Ca

Installing the Reference electrode Ref) and the Junction electrode (Jun)

- Insert the Reference electrode.
- Connect the white connector to the measuring chamber cartridge.
- Insert reference tube in upper tube guide of the left locking lever and in the tube holder of the cover hinge (see Fig. 8).
- Insert the Junction electrode.
- Connect the gray connector to the measuring chamber cartridge.
- Insert tube of Junction electrode in the tube guide of the Reference electrode, the bottom tube guide of the left locking lever and in the tube holder of the cover hinge (see Fig. 8).
- Close the locking lever.
- Check whether the electrodes are properly seated and electrical contact is established.
- Close the cover of the measuring chamber and scan the barcode printed on the package of each electrode.
- Follow the instruction on the screen.

MSS measuring chamber setup

for glu/lac - operation:
reference contact electrode **RCon**

for glu/lac/urea - operation:
reference electrode + dummy electrode

MSS cassette
(dummy cassette installed in new instruments)

The following procedure describes the installation of a **RCon**:
(The installation of a reference electrode and dummy electrode (for glu/lac/urea) is analog with the installation of a **RCon**.)

- Open the MC cover, the contact clip and the locking lever.
- Insert the **RCon** and the MSS cassette as shown in Fig. 9.

NOTE: *Always hold the MSS cassette by the handle only and make sure not to touch the contacts!*

*Make sure not to wedge the **RCon** and the MSS cassette during insertion.*

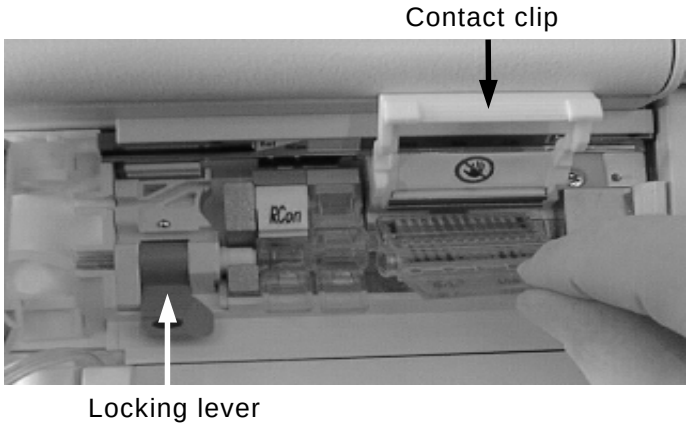
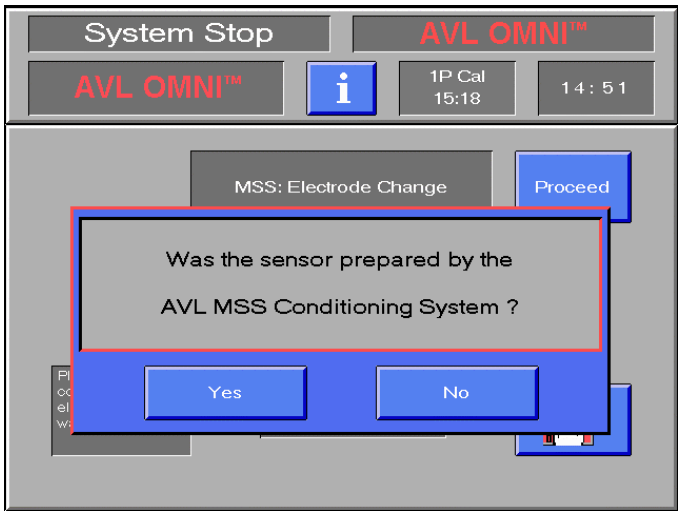


Fig. 9: Installing the **RCon** and the MSS cassette

- Close locking lever, contact clip, MC cover and analyzer cover.
- Scan the barcode printed on the package of the **Rcon**.
- Prepare a syringe or a capillary filled with whole blood (only if sensor is not preconditioned with MSS conditioning system) and read the barcode from the MSS cassette package.

NOTE: *The sample should not be older than 24 hours, contain heparin as an anticoagulant and have a volume of min. 150 µl.*

- The following message appears on the screen:



- If the sensor is not preconditioned, respond with "**No**" and follow the instructions on the screen.
  The sensor will then be wetted, polarized, warmed up and calibrated.
  Selecting "**Yes**" initiates a warm-up phase.
- Wait for the completion of warm-up and calibration of BG and ISE (and/or MSS, if the sensor is preconditioned).
- Press "**System - Cal - COOX/tHb Cal.**".
  Initiate a COOX/tHb calibration (see Operator's Manual, Chapter 6, "Calibration", "COOX/tHb-Calibration") by pressing the "**Start**" key.
  In the meantime pay attention to the insert sheet of the MSS cassette (GLU/LAC- or GLU cartridge).

34. Open the printer cover (siehe Fig. 1, ⑧).
35. Remove the paper roll spindle.

NOTE: *The printer paper is heat sensitive on one side only. Ensure that the paper roll is inserted properly.*

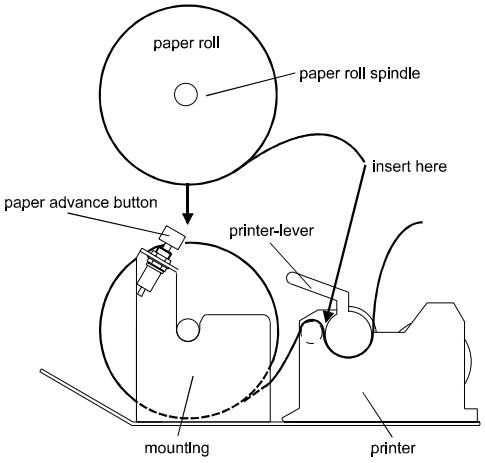


Fig. 10: Inserting printer paper

36. Put the new paper roll on the spindle.

37. Insert the paper roll in the printer (see Fig. 10) and press down carefully.
38. Cut the paper edge at a right angle.
39. Push the printer lever down.
40. Thread the paper edge behind the upper rubber roller.
41. Pull the printer lever up.
42. Press the paper advance button until the paper comes out of the print slot (see Fig. 10).

If necessary, adjust the printer in the following manner:

43. Push the printer lever down.
44. Adjust the printer paper tightening around the rubber roller.
45. Pull the printer lever up.
46. Close the printer cover.
47. lf the paper take-up unit (optional) is installed on the rear panel of the AVL OMNI™ place the printer paper on the spindle and push the three-prong spool over it.
    Activate the paper take-up unit under "**System - Setup - Miscellaneous - Thermal Printer - Paper Take-up Unit**".
48. If your AVL OMNI™ includes an AutoQC module (option), activate the module under "**System - Util - Service Area - Switches 1 - AutoQC ON**" as well as the ACQ temperature sensor under "**System - Setup - QC - AutoQC - AQC Temperature Correlation**".
    For installation of ampoule mats and all settings necessary for operation of the AutoQC module, please refer to the AVL OMNI™ Operator's Manual.
49. Test the function of the pump and the pump tubing set in the menu "**System - Util - Analyzer Actions - PP Tubing Exchange**".
50. Activate a printout of the calibration report by pressing:
    "**Options - Reports - Last Cal.**"
    or
    "**System - Setup - Edit Reports - Calibration Report**".
51. If the message "***Check Date/Time***" appears, it can be reset by setting the date and time under "**System - Setup - Miscellaneous - Times and Intervals - Date/Time**".
52. Assemble analyzer cover.
53. Return to the "**Ready**" or "**Warm-up**" screen. A system calibration will be performed.

Shutdown procedure

Less than 24 hours

If the AVL OMNI™ is turned off for less than 24 hours, please press "**System**" and turn off the analyzer.

NOTE: *Glu/lac/urea - sensors will be destroyed if they are not stored in the MSS conditioning system.*

If the AVL OMNI™ is not used for an extended period of time, a shutdown procedure must be performed before turning the analyzer off.

More than 24 hours

If the AVL OMNI™ is to be shut down for more than 24 hour perform following steps.

Please press:

"**System - Util - Analyzer Actions - Shutdown**".

NOTE: *To perform the shutdown procedure, follow the instructions on the screen.*

1. Connect the Shutdown tubing set to the corresponding suction tubes (see Fig. 11); the tubes with the rigid ends are connected to the Reference solutions.
   Remove the bottle of Solution 6 and place the tube in a container with distilled water.

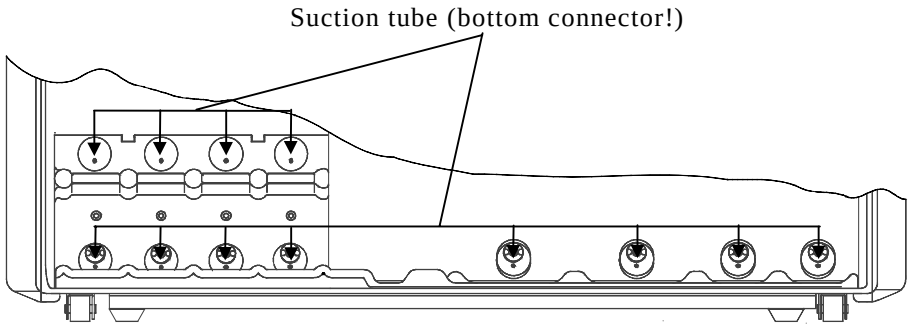


Fig. 11: Bottle compartment (section)

2. Press the key "**Continue**".
   Recommendation: During the washing procedure, remove the shutdown tubing set again and again briefly (approx. 1 sec. and than 3 sec. in the water) from the container with distilled water to enable aspiration of air segments.
   This measure improves the washing procedure.
   After completion of the washing routine, remove the shutdown tubing set and the container with distilled water.
3. When the prompt to remove electrodes and PP tubing set appears, open the analyzer cover.
4. Open the measuring chamber, by pressing the measuring chamber cover gently to the left.

5. Open the locking lever (and the contact clip at MSS measuring chamber; see 4-7) and remove the electrodes as well as the **RCon** (or the **reference elctrode** and the **dummy electrode** for urea) and the MSS cassette. Close the cover of the measuring chamber and the cover of the AVL OMNI™.
6. Pull the touch screen forward.
7. Open the PP cover behind the screen.

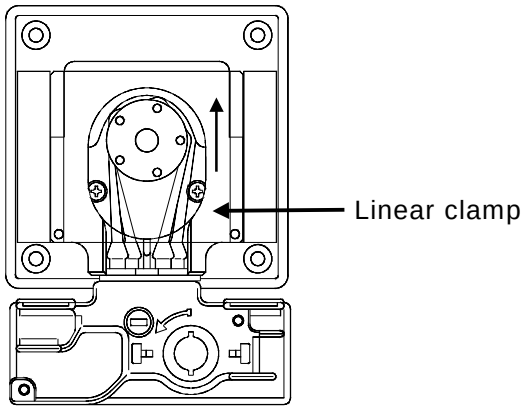


Fig. 12: Releasing the pump tubes

8. Relieve the tubes of the peristaltic pump.
   To do this, open the plexiglas cover (tension lever) of the peristaltic pump and push the linear clamp (white plastic part) in the direction of the arrow (see Fig. 12).
9. In case of a transport, remove the complete tubing set (tube holder and tubing) and close the plexiglas cover (tension lever) and the PP cover.
10. Press the key "**Continue**" and follow the instructions on the screen (see also Fig. 5).

Further (see also Fig. 1)

11. Unscrew the peristaltic pump cartridge ②.
12. Remove valve cap from valve V4[2] ③ (tube releasing).
13. (With devices, serial number < 5000, insert relief clamp ④ at the valve V3.)
14. Remove sample drip tray ⑤.
15. Tip the screen in the upward direction.
16. Open the cover of the AVL OMNI™.
17. Secure the sample distributor cartridge cover ⑦ with a foam rubber block.
18. Close the cover of the AVL OMNI™.

[2] Without tHb- or COOX-modules (AVL OMNI™ 1, 4 and 7) insert relief clamps.

19. Tip the screen in the forward direction.
    Protect the screen by inserting a foam rubber block between device cover and screen.

20. *If your AVL 0MNI ™ includes an AutoQC module, also insert the relief clamp for the magnetic valve (see Fig. 16, **12**).*

    If the AVL OMNI™ is transported long distances, the AutoQC module should be removed.
    Removal is decribed in chapter 5, under "Changing the AQC optical light guides (AQC cable tree)".
    Cables and tubings protruding from the AVL OMNI™ after removal of the AutoQC module must be secured to prevent damage.

    When starting up the AVL OMNI™ again after the AutoQC module has been removed and not been reinstalled, make sure that the optical ring bus (Optobus) is closed again.
    In this case install the AutoQC DemoKit GD0211 as described in the installation instructions AT0437 (see also page 4-14, Fig. 13).

21. Now the AVL OMNI™ can be transported without any problems. For a new installation, please follow the instructions under section "Installation", page 4-1.

Installation of the AutoQC module (option)

NOTE: *The current assembly instructions apply only to devices and where the AutoQC module was part of a first installation of an AVL OMNI™ with a SN ≥ 5000.*
If the AutoQC module is installed as part of an upgrade action, please use the installation instructions provided with the AutoQC module.

1. Pull off the right side panel (side of the floppy drive).
2. Open the cable clips and pull off the optical light guides (see Fig. 13, **2** and **3**) and the AQC wash tube (**4**) from the opt coupler.
   Remove the protective covering from the barex tube.

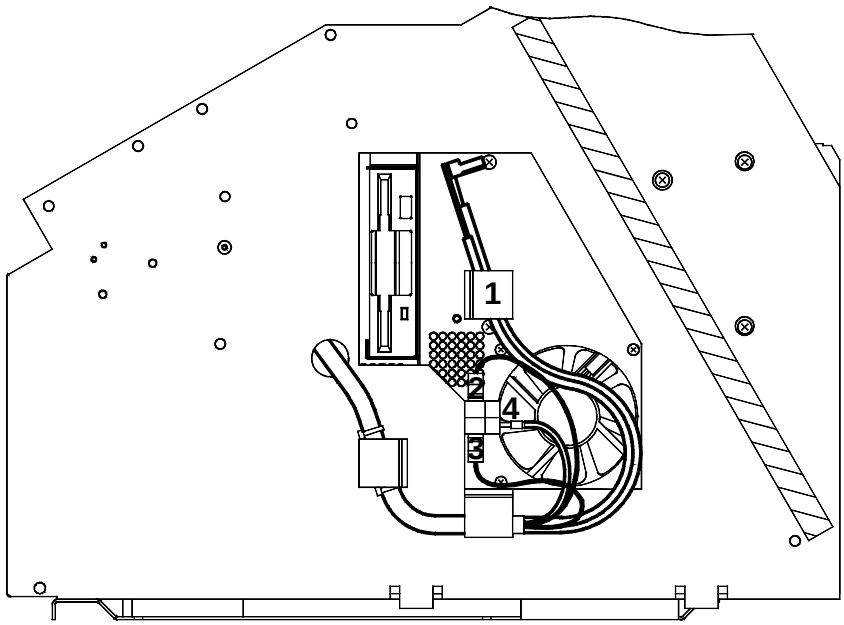


Fig. 13: AQC cable tree

3. Remove the covering cap from the side panel of the AVL OMNI™ and place the AQC cable tree through the boring.

NOTE: *Make sure that the bending radius of the AQC wash tube (silicon tube) is as large as possible.*

Do not bend or pinch the AQC wash tube or the optical light guides!

4. Secure the side panel of the AVL OMNI™.
5. Pull the AVL OMNI™ (side of the floppy drive) about 10 cm over the table edge.
6. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
7. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 16).

8. Disassemble the horizontal slide cover by loosening the two screws (see Fig. 16, **9**).
9. Open the cable clip of the AutoQC module (see Fig. 16, **10**).
10. Place the AQC cable tree in the cable clip.
11. Push the AutoQC module between the two metal parts of the bottom tray of the AVL OMNI™ and secure it with the two fastening screws M4x8 (DS0168).
12. Close the cable clip.
13. Remove the protecting caps from the connectors of the AQC control board and connect the optical light guides (see Fig. 14 and Fig. 16, **4**).
    The transmitter (TX) is labeled with a white dot.

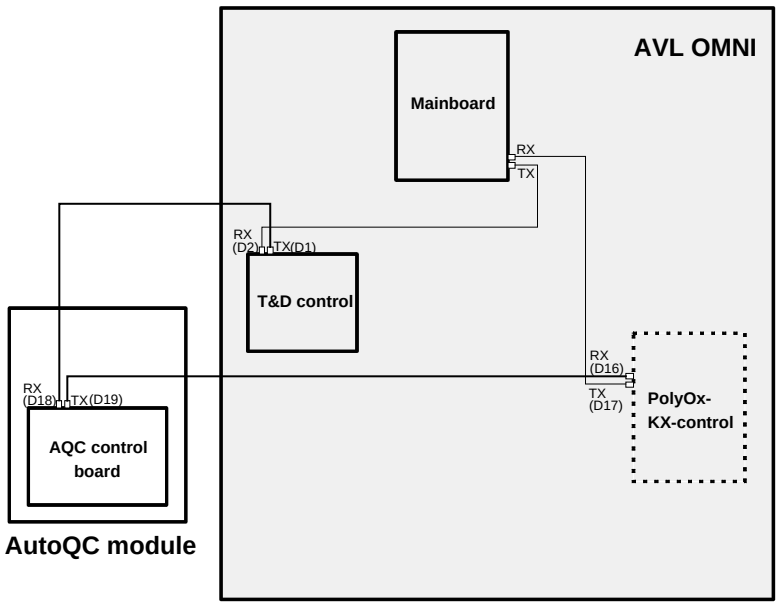


Fig. 14: Laying of light guides

14. Put the power supply cable through the cutout in the AQC control board cover and connect it to the AQC control board (see Fig. 16, **13**).
15. Place the barex tube (see Fig. 16, **5**) through the boring in the horizontal slide (see Fig. 16, **6**) and under the attachment screw (see Fig. 16, **7**) and tighten the attachment screw.
    The barex tube should protrude from the holder approx. 4 mm (up to the label).
16. Connect the tube from the steel tube to the barex tube (see Fig. 16, **14**).

NOTE: *Make sure that the tube is not bent.*
Adjust position of barex tube if necessary.

17. Connect the AQC wash tube to the elbow nipple (see Fig. 16, **2** and **3**).
18. Remove the red relief clamp from the magnetic valve.
    The relief clamp can be easily removed by pushing down on the magnetic valve (direction of the arrow, see Fig. 16, **12**).

19. Remove the fastening strap and the two fastening screws (see Fig. 15).

HINWEIS: *The fastening screws are used solely for securing the horizontal and vertical slide and should be reinserted only for transportation of the AutoQC module.*

(Fastening strap!)
Fastening screws for horizontal and vertical slide

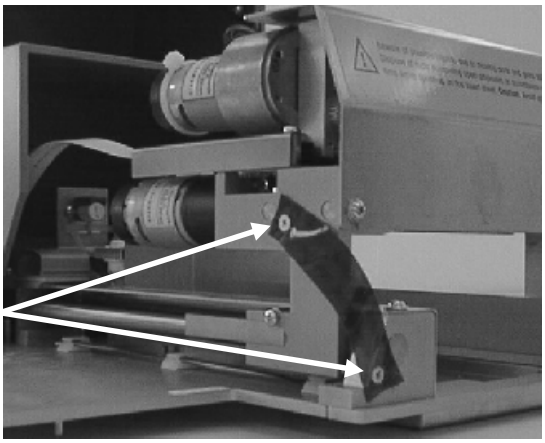


Fig. 15: Securing screws for vertical slide and horizontal slide

20. Secure the horizontal slide cover (see Fig. 16, **9**).
21. Hang the housing on the bolts (see Fig. 16, **11**) and secure it with the two fastening screws (see Fig. 16, **1**).
22. Hang the cover of the AutoQC module on the bolts and pull it forward until it engages.
23. Continue with item 11 on page 4-3.

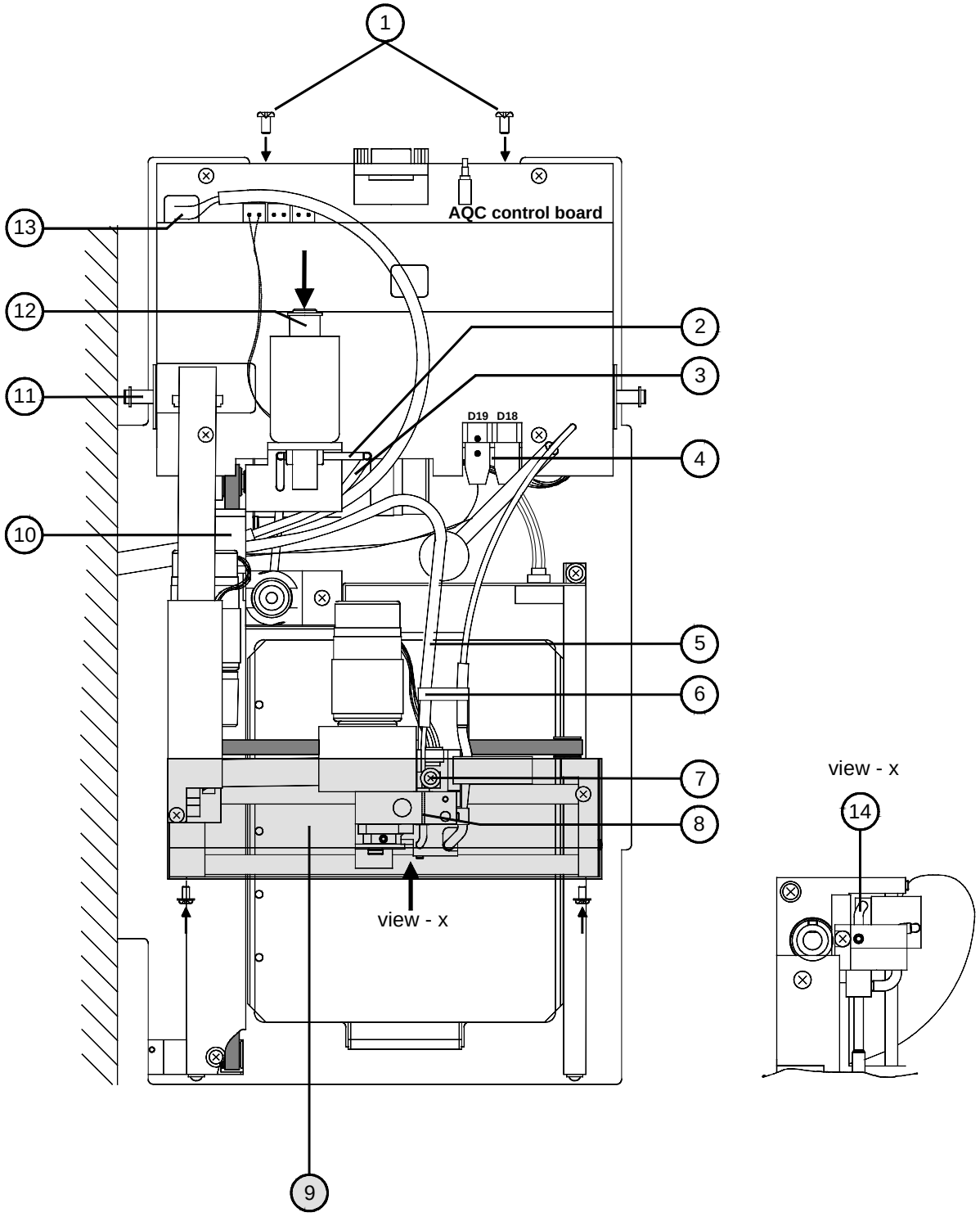


Fig. 16: AutoQC installation

Options

Reusable Waste container

Description see AVL OMNI™ Operator's Manual, chapter "**Appendix**", section "**Options**".

External Waste container

Description see AVL OMNI™ Operator's Manual, chapter "**Appendix**", section "**Options**".

Barcode scanner

Description see chapter "Function modules from A - Z".

Keyboard

See also chapter "Function modules from A - Z", section "PC components – Interface board AVLIFB".

Paper take-up unit

for thermal printer.

MSS Conditioning System

For detailed information please contact your AVL representative.

AVL OMNILink™

AVL OMNILink™ is a user friendly software package which allows a supervisor to remotely monitor and manage one or more AVL OMNI™ analyzers distributed around a hospital or hospital network.
From the supervisor's PC (Windows 9x/NT), the complete analyzer status can be easily and continuously monitored without any analyzer interruption whatsoever. Information about the analyzer including calibration data, quality control and patient results, error and maintenance logs can also be obtained.
For more information, please contact your local AVL representative.

List of modifications, chapter 5 (Function modules from A - Z)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
General information on assembly and disassembly of components			•		•, Δ	Δ	
Aerosol trap							Δ
AutoQC module (option)				Δ	•, Δ	Δ	
Bacterial filter			Δ				
Barcode control and barcode scanner		Δ		Δ	•	•	•
Bypass cartridge			•				
Cable trees, flat cables, single cables and photoconductors							•, Δ
Container pipes			•		•, Δ		
Fan and filter							
Fill level sensors - Waste cap with fill level detection			•		•, Δ		
Fluid mixing system (FMS)				Δ			•
Hemolyzer							•
Mainboard			•		•		•
Measuring chamber general				Δ			•, Δ
Blood gas (BG) measuring chamber		•, Δ					
ISE measuring chamber		•, Δ					
MSS measuring chamber					Δ	Δ	•, Δ
Measuring chamber cartridge		•	•				
COOX module	Δ	Δ	•, Δ				•
tHb measuring chamber and tHb cartridge					Δ		•
Motherboard							
Power supply unit		•			•		
PC components		•	Δ		•, Δ	Δ	•, Δ
Display		•			•		
Peristaltic pump (PP)			•, Δ				
PP cartridge			•				

- • Modification (previous states of revision see chapter 10, "Previous revision levels")
- Δ New or addition !

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Pre-filter				Δ			
Sample distributor (SD)			Δ		•, Δ		•
Thermal printer			Δ				
T&D system				Δ	•, Δ		
Vacuum sensor							
Vacuum pump							Δ
Valves	•		•		Δ		•, Δ
Figures		•, Δ	•		•, Δ	•	•, Δ

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
General information on assembly and disassembly of components							
Aerosol trap							
AutoQC module (option)	Δ						
Bacterial filter							
Barcode control and barcode scanner							
Bypass cartridge							
Cable trees, flat cables, single cables and photoconductors							
Container pipes							
Fan and filter							
Fill level sensors - Waste cap with fill level detection							
Fluid mixing system (FMS)	Δ						
Hemolyzer	•						
Mainboard	•, Δ						
Measuring chamber general							
Blood gas (BG) measuring chamber							
ISE measuring chamber							
MSS measuring chamber							
Measuring chamber cartridge							
COOX module							
tHb measuring chamber and tHb cartridge							
Motherboard							
Power supply unit							
PC components	•, Δ						
Display							
Peristaltic pump (PP)	Δ						
PP cartridge							

- • Modification (previous states of revision see chapter 10, "Previous revision levels")
- Δ New or addition !

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Pre-filter							
Sample distributor (SD)							
Thermal printer							
T&D system							
Vacuum sensor							
Vacuum pump							
Valves	•, Δ						
Figures	Δ						

- • Modification (previous states of revision see chapter 10, "Previous revision levels")
- Δ New or addition !

5 FUNCTION MODULES FROM A - Z

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5 Function modules from A - Z

General information on assembly and disassembly of components

CAUTION! *After assembly replacement existing calibration parameters may have changed or values may have to be reentered.*
It is therefore necessary to perform a system calibration after modifications have been made, to adjust the calibration parameters to the new settings.

System calibration and updating setup values is recommended especially after exchanging the following components:

- *Bypass cartridge*
- *FMS*
- *Mainboard (O2-UPol, Baro S value, actual barometric pressure)*
- *Measurement modules (set O2-UPol)*
- *PC tower and hard disk (print status report):*
  All data manager values and customer settings will be lost!
  (O2-UPol, Baro S value, actual barometric pressure, COOX offset values, sample counter, hotline number, serial number, AutoQC serial- and revision number as well as number of total measurements)
- *PP tubes*
- *Sample distributor incl. SD cartridge*
- *Barometer sensor (Baro S value)*

Please switch off the AVL OMNI™ before installing or mounting mechanical or electronic components.

*If the AVL OMNI™ is turned off for less than 24 hours, please press "**System**" and turn off the device.*
(It is also recommended to perform a shutdown procedure with the shutdown tubing set, so that no residual fluid may enter the AVL OMNI™ during assembly.)

*A shutdown with the shutdown tubing set is necessary when the AVL OMNI™ is turned off for more than 24 hours. In this case, please activate "**System - Util - Analyzer actions - Shutdown**" and follow the instructions on the screen (see also Service Manual, chapter 4 under "Shutdown").*

The following procedure (unless described differently), is necessary for the assembly and disassembly of most of the components in the AVL OMNI™:

1. Open the analyzer cover and remove in an upward direction.
2. Remove the sample distributor cover (see Fig. 86, **3**).
3. Tip the screen in the forward direction.
4. Open the bottle compartment cover.
5. Pull off the tubes **1**, **2** and **3** (see Fig. 1) from the sample distributor.

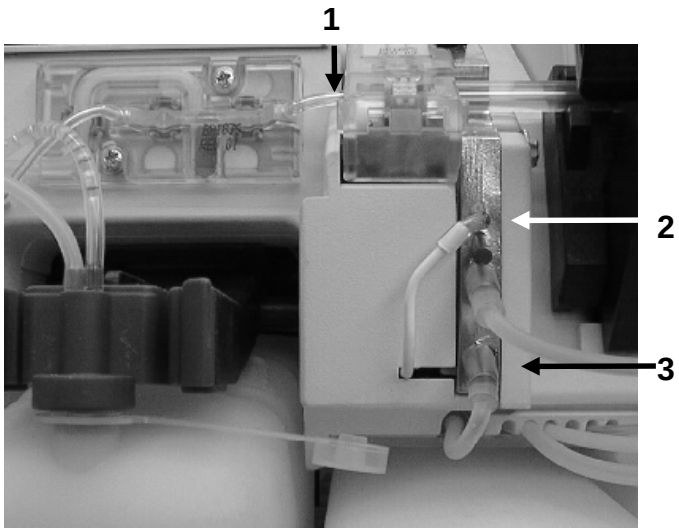


Fig. 1: Disconnecting the tubes from sample distributor

6. Disconnect all cables (power cable, barcode, etc.) from the AVL OMNI™.
7. Open the Phillips screws on the back of the analyzer.
8. Remove the rear panel diagonally in the upward direction.
9. Remove the grounding plug from the rear panel.
10. Unscrew the two Phillips screws which hold the measuring chamber plate, and pull up until it clicks into place.

NOTE: *When the measuring chamber plate is pulled up, the thermal printer paper slips out of the paper feed. Please be sure that the thermal printer paper is located in the paper feed when closing the measuring chamber plate.*

Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain remnants of biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Aerosol trap (applicable from SN 5000 on)

Function

The aerosol trap is used to prevent fluids (waste) or solid particles from being aspirated into the vacuum pump.

Changing the aerosol trap

When changing the aerosol trap, please proceed as follows:

1. Switch off the AVL OMNI™.
1. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
2. Gain access to the rear of the analyzer.
3. Pull off the tubels from the aerosol trap.
4. Open the cable clip.

Fig. 2: Aerosol trap

NOTE: *Assure correct installation position of the aerosol trap. The tubes must point upward (see figure).*

AutoQC module (optional)

NOTE: *When transporting the AVL OMNI™ with AutoQC module installed, do not use the AutoQC module to carry the instrument.*

Never operate the AutoQC module with open cover!

Function

The AutoQC module is a unit which, in conjunction with the AVL OMNI™, performs automatic quality control measurements at times pregrogrammed by the user.
The module consists of the ampoule holder for 120 ampoules maximally, and a steel tube which, after being positioned by motors (in Y-, Y-, and Z-direction), breaks the bottom of the ampoule and withdraws QC fluid. The aspirated QC fluid is transported to the respective measuring chambers or modules via the T&D module, the sample inlet path and the sample distributor and then measured.
The results of the QC measurement are stored in memory and possible consequent actions are initiated.

For installation of ampoule mats and all settings necessary for operation of the AutoQC module, please refer to the AVL OMNI™ Operator's Manual.

Electronic

The electronics of the AutoQC module are comprised of 3 boards:

- **AQC control board**: main board including microcontroller
- **YZ-distributor board**:
  contains all connectors for the Y-drive and is responsible for transferring the signals from the AQC control board to the Z-distributor board.
- **Z-distributor board:**
  contains all components for the Z-drive (light barrier-Z, connector for z-drive) and sample sensor.

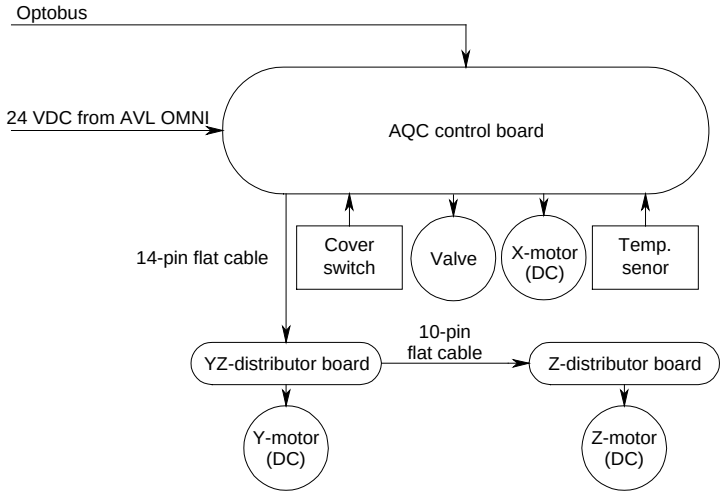


Fig. 3: Block diagram - AutoQC

AQC control board

Main board including microcontroller, motor drivers, valve drivers, etc. to control the AutoQC module.

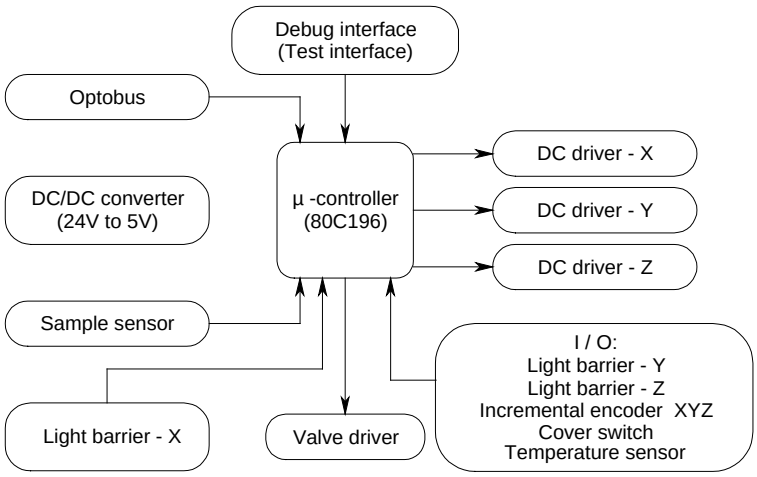


Fig. 4: Block diagram - AQC control board

DC converter

The module is supplied with 24 V by the AVL OMNI™.
The required 5 V are directly generated on the AQC control board.
The two voltages are indicated by one LED each.

µ-controller

The same micro-controller (80C196KC) and an almost identical structure as that on the Mainboard are used. The software is stored in a RAM and can be updated or reloaded after data loss caused by prolonged power-off (typically 3 months) via the PC of the AVL OMNI™.
The assembly was complemented with an EEPROM for storing serial and revision numbers of electronics and mechanics and the nurnber of measurements performmed with this module. The two serial interfaces are for the time being used only for testing purposes.

Optobus

This module is tied into the internal communication ring, the Optobus of the AVL OMNI™, comparable to the T&D control or PolyOx-KX control 9700 LY3.

NOTE: *An interruption of the power supply to the module also interrupts the communication within the AVL OMNI™ and causes a total system failure.*

DC-X/Y/Z

3 identical DC motors control the unit in all 3 axes. The current and thus the momentum of the motors can be limited to a maximum value via the software. The distance covered and the rotational speed are measured by an incremental position transducer integrated in the motor.
The absolute position is determined by light barriers in the home position (wash position).

Valve driver: the monostable valve is triggered by a Darlington transistor. The switch-on time of the valve is limited by the software to 30 seconds maximally.

Sample sensor

Sample detection is performed via a light barrier located on the Z-distributor board.
To compensate for mechanical tolerances, scattering and ageing, the send-LED can be operated with a constant current from 0.25 to 60 mA. It is calibrated before each measurement. The switch-on time of the LED is limited to 560 µs by the electronics.

Light barrier

A transmissive photointerrupter is used in all 3 axes. The light barrier for the X-direction is directly on the AQC control board.

Cover switch

The cover of the AutoQC module is monitored by a hall sensor. When the cover is opened, all mechanical actions are stopped by the software (except actions in the Component Test).

Temperature Sensor

The ampoule ambient temperature is measured by the temperature sensor and used for correction of QC measurement values (PO_2 and $_PCO2$ only).
The measured value and the status of the temperature sensor can be read under "**System - Test - Component Test - Aggregates - AutoQC - Temp. Sensor**".
The measured data is transferred digitally to the AQC control board.
Only AutoQC values are being corrected, not values from manual QC measurements.

NOTE: *Do not install or remove the AQC temperature sensor when the system is connected to power.*

YZ-distributor board

The YZ-distributor board distributes the signals from the AQC control board to the Y-motor (DC) and to the Z-distributor board. The light barrier for Y (transmissive photointerrupter) is located directly on the board.

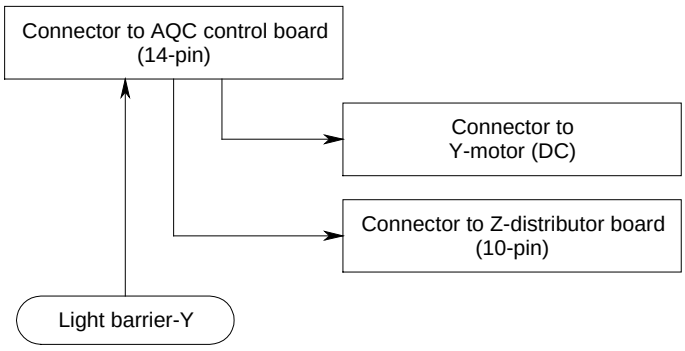


Fig. 5: Block diagram - YZ-distributor board

Z-distributor board

The Z-distributor board distributes the signals from the YZ-distributor board to the Z-motor (DC). The light barrier for Z (transmissive photointerrupter) and the sample sensor (light barrier) are directly located on the board.

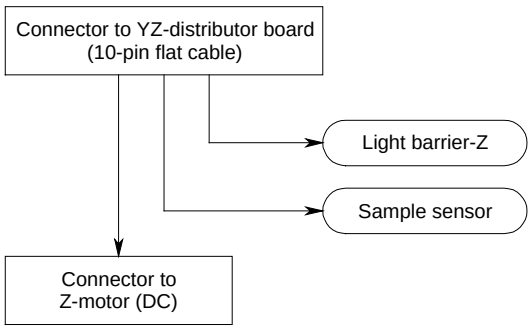


Fig. 6: Block diagram - Z-distributor board

NOTE: *Moving the unit into the service position as described in the following may in some cases only be partly or not at all possible due to defective components. lt should, however, be performed at any rate to facilitate service work.*
If the service positions cannot be approached at all, the vertical and the horizontal slide can be moved manually, by removing the toothed belt from the carrier pins of the vertical and/or horizontal slide.

Changing the AQC control board

Electrostatic Sensitive Device

When changing the AQC control board (see Fig. 12), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
4. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 12).
5. Remove the cover of the AQC control board by removing screws **6** and **35** (see Fig. 12).
6. Disconnect all cables from the AQC control board and the cable from the AQC temperature sensor.

7. Remove screws **2** and **39** (see Fig. 12) and remove the two spacer bolts **11** (see Fig. 13).

Assembly is done in reverse order.

NOTE: *Reestablish serial number and revision number as well as the value of total measurements (if requested).*
See chapter 8, "AutoQC (Optional)".

*Activate the program "**System - Util - Service Area - AutoQC Adjustment**" to perform a position adjustment in X- and Y-direction.*

Changing the barex tube

When changing the barex tube (see Fig. 12, **12**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
4. Pull sample drip tray down and out.
5. Press the T&D flap in the direction of the arrow (see Fig. 7).
6. Disconnect the tube at the barex tube from position **10** of the T&D flap (see Fig. 7).
7. Pull off the clamp (see Fig. 7).

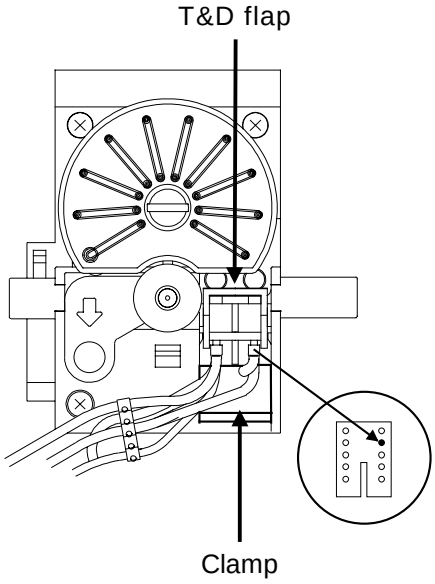


Fig. 7: Changing the barex tube (1)

8. Pull the barex tube out of the T&D module from the back.
9. Open the cover of the AutoQC module.
10. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).

11. Remove Phillips screw from the horizontal slide (siehe Fig. 12, **16**) and disconnect barex tube from the tubing at the steel tube.
12. Unscrew the sleeve from the sheathing of the barex tube (see Fig. 8).

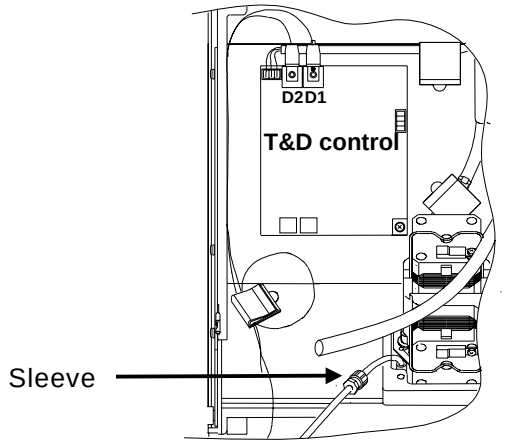


Fig. 8: Changing the barex tube (2)

13. Pull the barex tube from its sheathing.

Assembly is done in reverse order.
Please refer to the retrofit instructions enclosed with the spare part.

NOTE: *Do not bend the new barex tube when placing it into the sheathing!*

Changing the magnetic valve

When changing the magnetic valve (see Fig. 12, **36**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
4. Disassemble the housing of the AutoQC module by loosening the two screws **1** (see Fig. 12).
5. Remove the cap and the relief clamp from the magnetic valve (see Fig. 13, **7** und **8**).
6. Remove the two screws from the magnetic valve.
7. Disconnect the magnetic valve cable.

Assembly is done in reverse order.

Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Valve - Switch Valve**", to check the function of the magnetic valve.

Changing the YZ-distributor board

Electrostatic Sensitive Device

When changing the YZ-distributor board (see Fig. 12, **27**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module.
4. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
5. Loosen screw **25** and remove the cable guide in the direction of the arrow (see Fig. 12).
6. Disconnect the motor cable (see Fig. 12, **31**).
7. Disconnect the flex cables (short and long) from the YZ-distributor board (Caution - connector lock!).
8. Remove the spacer bolt and the screw (see Fig. 12, **28**).
9. Remove the YZ-distributor board.

Assembly is done in reverse order.

Changing the Z-distributor board

Electrostatic Sensitive Device

When changing the Z-distributor board (see Fig. 12, **15**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module.
4. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
5. Remove screw **16** (see Fig. 12) and disconnect all cables from the Z-distributor board.
6. Remove the Z-distributor board.
   (If the vertical slide is in the top 0-position, also remove screw **2** and axis **18**; see Fig. 13.)

Assembly is done in reverse order.

NOTE: *The connector of the flex cable (short) is not coded, therefore make sure that the contacts are installed pointing toward the AVL OMNI™!*

Changing the flex cable (short)

When changing the flex cable (short) (see Fig. 12, **24**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module.
4. Disassemble the horizontal slide cover by removing the two screws **12** and **16** (see Fig. 14).
5. Loosen screw **25** and remove the cable guide in the direction of the arrow (see Fig. 12).
6. Open the connector locks and replace the flex cable.

Assembly is done in reverse order.

NOTE: *The connector of the flex cable (short) is not coded, therefore make sure that the contacts are installed pointing toward the AVL OMNI™!*

Changing the flex cable (long)

When changing the flex cable (long) (see Fig. 12, **36**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
4. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 12).
5. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
6. Loosen screw **25** and remove the cable guide in the direction of the arrow (see Fig. 12).
7. Remove the cover of the AQC control board by removing screws **6** and **35** (see Fig. 12).
8. Open the connector locks and replace the flex cable.

Assembly is done in reverse order.

NOTE: *The connector of the flex cable (long) is not coded, therefore make sure that the contacts are installed pointing toward the edge of the board or the light barrier.*

Changing the AQC optical light guides, AQC power supply cable or AQC wash tube (AQC cable tree)

When changing the AQC optical light guides (see Fig. 12, **7**), AQC power supply cable (see Fig. 12, **38**) or AQC wash tube (see Fig. 12, **5**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
4. Remove bottle A and B from the bottle compartment.
5. Pull off the AQC wash tube from the the cross nipple (see Fig. 9).

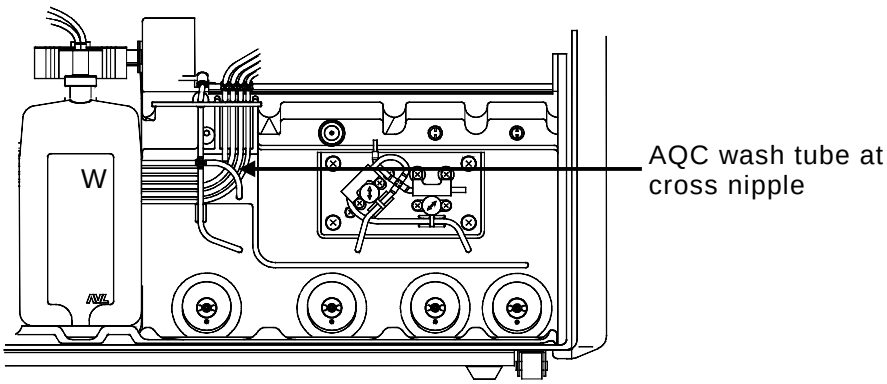


Fig. 9: AQC wash tube

6. Pull the AQC wash tube out of the bottle compartment from the back.
7. Pull sample drip tray down and out.
8. Press the T&D flap in the direction of the arrow (see Fig. 7).
9. Disconnect the tube at the barex tube from position **10** of the T&D flap (see Fig. 7).
10. Pull off the clamp (see Fig. 7).
11. Pull the barex tube out of the T&D module from the back.
12. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
13. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 12).
14. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
15. Remove the cover of the AQC control board by removing screws **6** and **35** (see Fig. 12).
16. Open the cable clip (see Fig. 12, **33**).
17. Disconnect the two optical light guides and the power supply cable from the AQC control board (see Fig. 12, **7** and **38**).

18. Remove Phillips screw from the horizontal slide (siehe Fig. 12, **16**) and disconnect barex tube from the tubing at the steel tube.
19. Pull off the AQC wash tube from the the elbow nipple (see Fig. 12, **5**).
20. Loosen the fastening screws of the AutoQC module on the bottom of the AVL OMNI™ and remove the AutoQC module.
21. Unscrew the right side panel (side of the floppy drive). The screws are accessible from the inside.
22. Open the cable clip at the side panel of the AVL OMNI™.
23. Remove the light guides from the T&D control and from the Mainboard (AVL OMNI™ 1, 2, 4, 5, 7 and 8) or the PolyOx-KX-control (AVL OMNI™ 3, 6 and 9).
24. Remove the power supply cable from the PC tower.
25. Remove the complete AQC cable tree and replace it with a new one.

Assembly is done in reverse order.

NOTE: *When installing the new AQC cable tree, make sure that the AQC wash tube is placed close to the housing wall of the AVL OMNI™ to ensure a large bending radius.*

Changing the X-motor

When changing the X-motor (see Fig. 12, **9**), please proceed as follows

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
4. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 12).
5. Remove the cover of the AQC control board by removing screws **6** and **35** (see Fig. 12).
6. Disconnect all cables from the AQC control board.
7. Remove screws **10** and **22** (see Fig. 12) to remove the cover of the vertical slide and pull off the metal plate in direction of the arrow.
8. Remove the two screws from the wash port holder (see Fig. 13, **13**).
9. Remove the two Phillips screws at the motor-wash port holder unit and remove the motor.
10. Remove the toothed disk from the motor and attach it to the new motor.

Assembly is done in reverse order.

Changing the Y-motor

When changing the Y-motor (see Fig. 12, **29**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module.
4. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
5. Loosen screw **25** and remove the cable guide in the direction of the arrow (see Fig. 12).
6. Disconnect the motor cable from YZ-distributor board (see Fig. 12, **31**).
7. (see Fig. 5-9, 1 and15)
8. Remove the fastening screws from the motor (see Fig. 14, **1** and **15**) and remove the motor.
9. Remove the toothed disk from the motor and attach it to the new motor.

Assembly is done in reverse order.

Changing the Z-motor

When changing the Z-motor (see Fig. 12, **18**)please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module.
4. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
5. Remove the slide plate (see Fig. 14, **2** and **3**).
6. Disconnect the motor cable Z-distributor board.
7. Remove screw **7** (Fig. 14) to remove axis **11**.
8. Remove the fastening screws from the motor (see Fig. 14, **4** and **5**) and remove the motor.
9. Remove the toothed wheel and the guiding sleeve from the motor and connect it to the new motor.

Assembly is done in reverse order.

Changing the steel tube complete

When changing the steel tube complete (see Fig. 14, **13**), please proceed as follows

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Open the cover of the AutoQC module.
3. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
4. Disconnect the tubing of the steel tube from the barex tube (see Fig. 14, **6**).
5. Use the 1.5 mm Allen wrench to remove screw **9** (see Fig. 14).
6. Pull the steel tube out toward the bottom.
7. Disconnect the tubing from the steel tube (see Fig. 14, **10**).

Assembly is done in reverse order.

NOTE: *Make sure that the connecting piece for the silicone tube points to the right.(see Fig. 14, **10**).*

Changing the AQC maintenance kit (steel tube complete, wash port and tube for valve)

The following parts have to be changed annualy:

- Steel tube complete (change see page 5-16)
- Tube for valve (see Fig. 12, **4**):
  Disconnect the tubing from the angle piece and replace it with a new one.
- Wash port (see Fig. 12, **30**)

When changing the wash port, please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
4. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 12).
5. Remove screw **32** (see Fig. Fig. 12) and remove the wash port angle.
6. Remove the wash port holder by pressing the two snap locks together.
7. Insert a new wash port into the wash port holder.

Assembly is done in reverse order.

Check position of wash port under "**System - Test - Component Test - Aggregates - AutoQC - Positions - Home Position**".

Changing the AQC temperature sensor

When changing the AQC temperature sensor (see Fig. 10 ◁), please proceed as follows:

1. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
2. Remove the ampoule mats, the ampoule holder and the AQC tray.
3. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
4. Switch off the AVL OMNI™.

NOTE: *It is necessary to power off the AVL OMNI™ to configure the new AQC temperature sensor. This is done after the boot procedure.*

Do not install or remove the AQC temperature sensor when the system is connected to power.

5. Disassemble the housing of the AutoQC module (see arrows Fig. 10).
6. Disconnect the cable from the AQC temperature sensor (see Fig. 10 ◁).
7. Remove screws **a** and **b** (see Fig. 10) and the vertical slide cover (see Fig. 11).

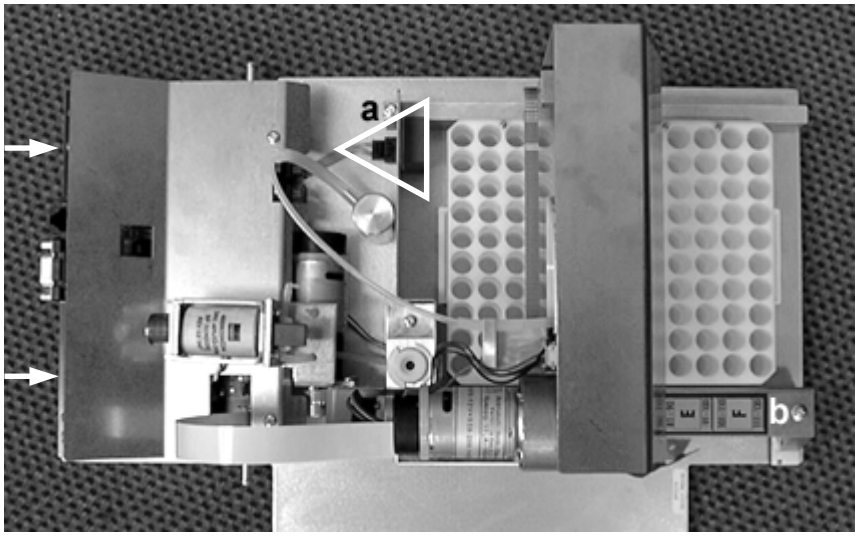


Fig. 10: Changing the AQC temp. sensor

8. Remove the AQC temperature sensor and clean the vertical slide cover removing any glue.

9. Paste the new AQC temperature sensor on the vertical slide cover (seeFig. 11).

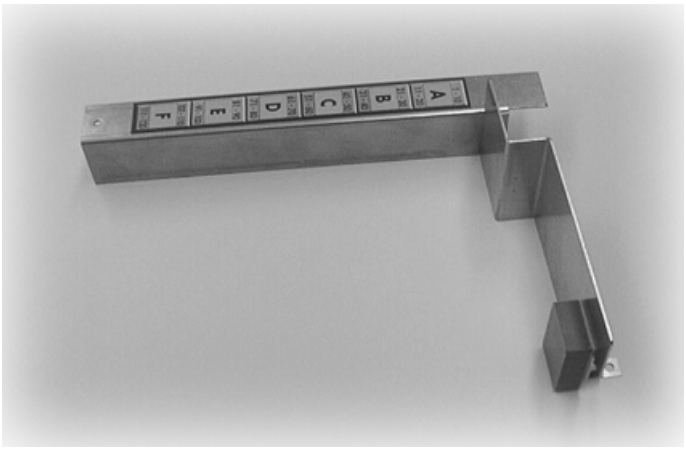


Fig. 11: Horizontal slide cover

Assembly is done in reverse order.

Check the functioning of the AQC temperature sensor under "**System - Test - Component Test - Aggregates - AutoQC – Temp. Sensor**".

Changing the toothed belt (short)

When changing the toothed belt (short) (see Fig. 12, **26**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Open the cover of the AutoQC module.
3. Disassemble the horizontal slide cover by loosening the two screws **12** and **16** (see Fig. 14).
4. Remove the screw at the carrying wheel (see Fig. 12, **13** and **14**) and remove the old toothed belt.
5. Stretch the new toothed belt over the toothed disk (see Fig. 14, **17**) and over the carrying wheel (see Fig. 12, **14**).
6. Fasten the toothed belt with screw **13** (see Fig. 12).
7. Place the toothed belt on the carrier pins of the horizontal slide (see Fig. 12, **17**).

Assembly is done in reverse order.

Changing the toothed belt (long)

When changing the toothed belt (long) (see Fig. 12, **23**), please proceed as follows:

1. Activate the program "**System - Test - Component Test - Aggregates - AutoQC - Positions - Service Position**", to move the motors into the service position.
2. Switch off the AVL OMNI™.
3. Open the cover of the AutoQC module and push it downwards to disengage it from the two bolts.
4. Disassemble the housing of the AutoQC module by removing the two screws **1** (see Fig. 12).
5. Remove the cover of the AQC control board by removing screws **6** and **35** (see Fig. 12).
6. Remove screws **10** and **22** (see Fig. 12) to remove the cover of the vertical slide and pull off the metal plate in direction of the arrow.
7. Remove the screw at the carrying wheel (see Fig. 12, **19** and **20**) and remove the old toothed belt.
8. Stretch the new toothed belt over the toothed disk (see Fig. 12, **34**) and over the carrying wheel (see Fig. 12, **20**).
9. Fasten the toothed belt with screw **19** (see Fig. 12).
10. Place the toothed belt on the carrier pins of the vertical slide (see Fig. 14, **14**).

Assembly is done in reverse order.

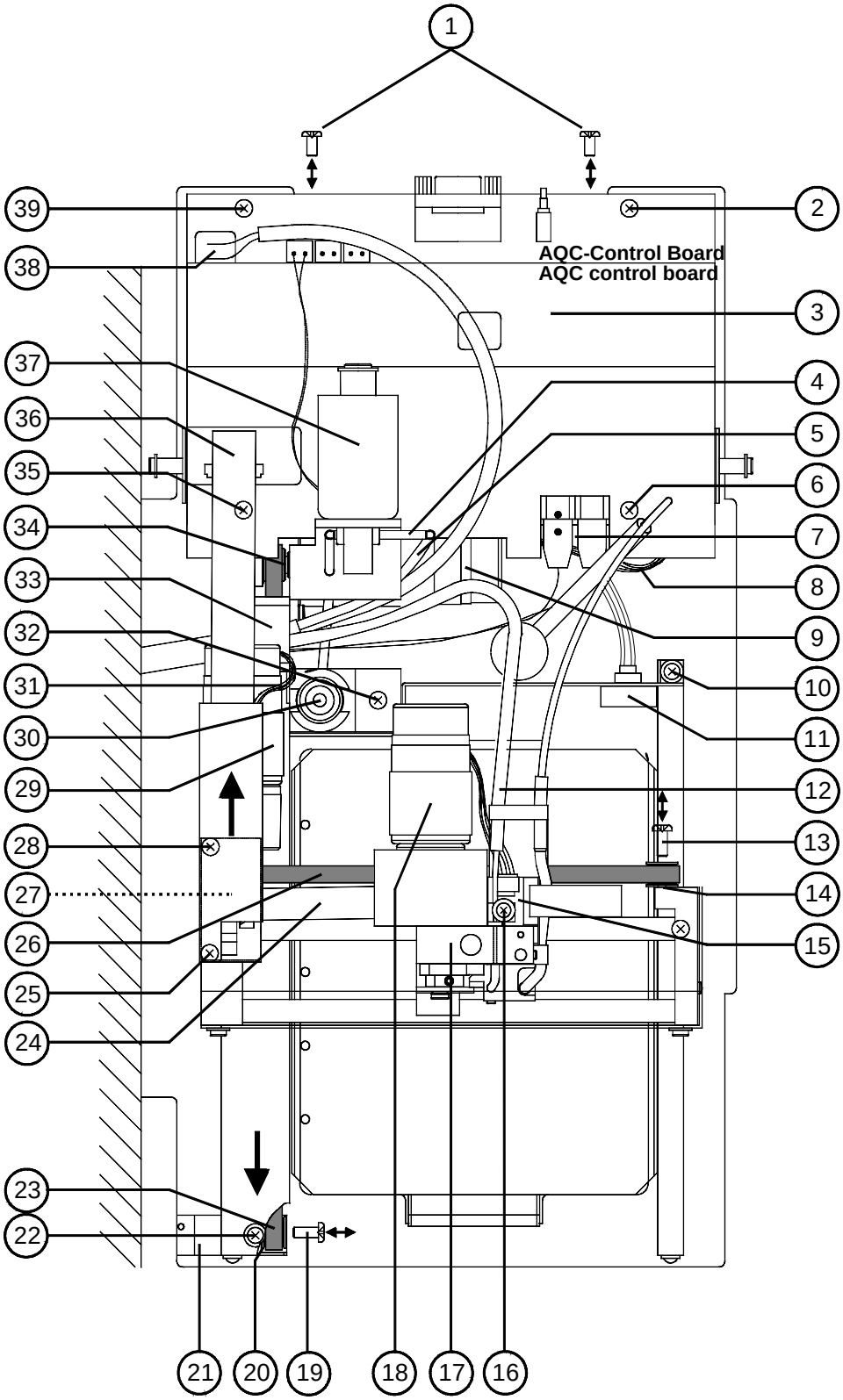


Fig. 12: AutoQC - top view

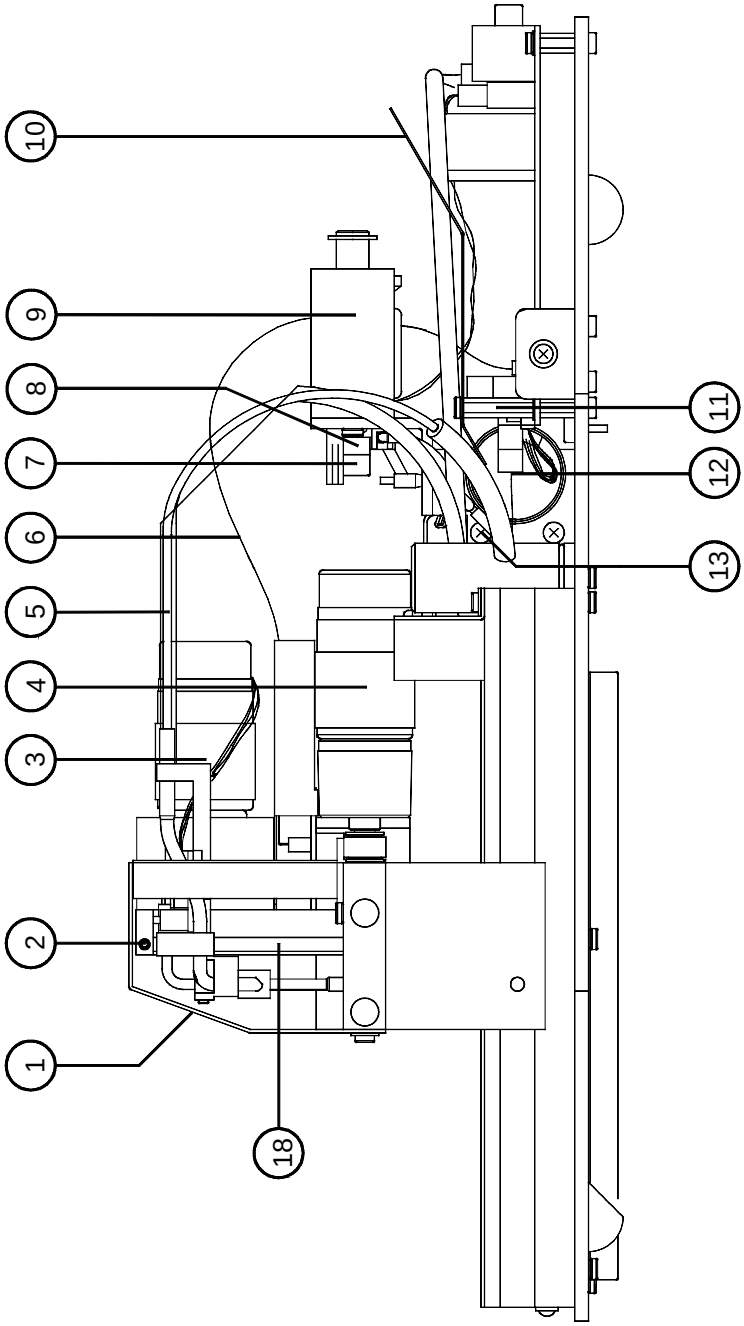


Fig. 13: AutoQC - side view

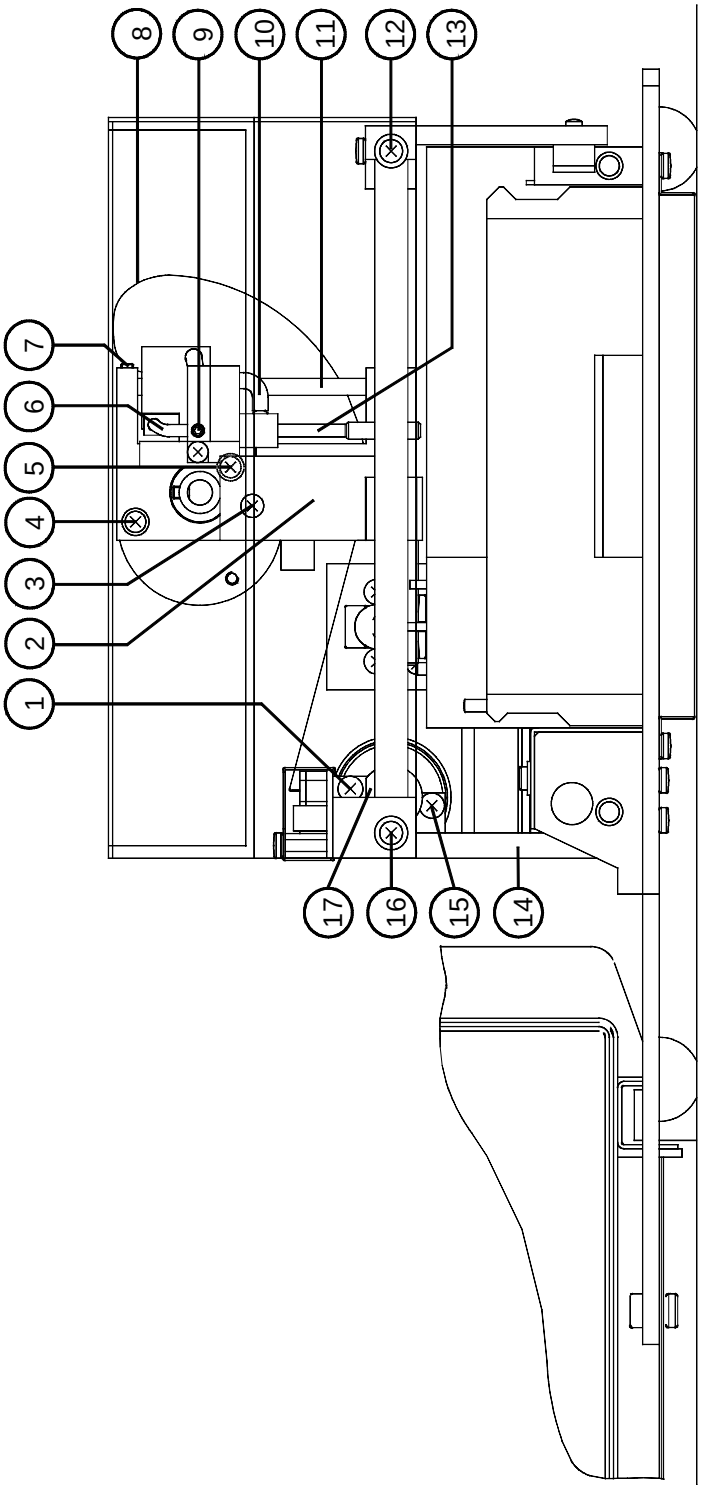


Fig. 14: AutoQC - front view

Bacteria filter

Function

The bacteria filter filters the air from the Waste container which contains biological fluids causing potential risks for infection.

Changing bacteria filter

When changing the the bacteria filter (see Fig. 86, **14**), please proceed as follows:

1. Open the bottle compartment cover and remove the Waste container.
2. The bacteria filter is held on its over and underside with two rubber parts. The bacteria filter can be removed from its holder by lifting.

Assembly is done in reverse order.

NOTE: *Please observe the installation position of the bacteria filter. The "INLET" label must point to the upper rubber part.*

Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.

Barcode control

Changing the Barcode control

Electrostatic Sensitive Device

When changing the Barcode control (see Fig. 85, **7**), please proceed as follows:

2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the 26-poled flat cable (dataline) from the thermal printer.
5. Unscrew the four Phillips screws, which hold the thermal printer and remove.
6. Disconnect all cables from the Barcode control.
7. Press the four white clamping bolts together and remove the board.

Assembly is done in reverse order.

Barcode scanner (optional)

Function

- Input of reagent data (type, lot number, expiration date, composition, etc.)
- Input of electrode data (type, expiration date, etc.)
- Input of patient or operator identification
- Input of QC-data (AVL COMBI-trol: material, lot number, base, expiration date, target values, etc.)
- Input of password

There are two ways to read in data:

- Hold the barcode scanner in your hand and swipe it across the respective barcode.
- With the barcode scanner positioned in the holder on the side panel of the AVL OMNI™, swipe the barcode past the wand. This permits the user to read in barcode data without having to touch the wand (e.g. with contaminated gloves).

NOTE: *Make sure the barcode holder is properly positioned on the right side panel of the AVL OMNI™, with the tip of the barcode scanner protruding past the housing frame.*

Barcodetype	Display
Code 2/5 Interleaved	
Code 39 / Full code 39	
Codabar	
EAN-8/UPC-E	

Fig. 15: Barcode types

The barcode scanner is preprogrammed for code types:

– **Code - 39**
– **Interleaved 2 of 5**
– **Codabar**
(Turning switch 8 “OFF” deactivates the Start/Stop character)
– **Code 11**
– **EAN-13**
– **UPC-AEAN-8 / UPC-E**
– **Code 128**
– **MSI / Plessey**

For these code types the following default settings of DIL-switches of SW2 at the Barcode control (see Fig. 85, **7**) are applicable:

Switch	Position
1	ON
2 - 5	OFF
6 - 8	ON

Bypass cartridge

Function

The bypass cartridge holds the bypass nipple and the sample distributor cover. The bypass nipple is the connecting piece between the sample inlet path, the sample distributor and the BC- or tHb cartridge. Its inner diameter is 1.0 mm. Also, together with the optical light guide, it incorporates detection position SS2, and is an essential component of the sample distribution process.

Changing the bypass cartridge

The bypass cartridge is maintenance free and is only to be changed when damaged.

When changing the bypass cartridge (see Fig. 86, **8**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2, under "General information on assembly and disassembly of components".
3. Pull sample drip tray down and out.
4. Remove the fill port adapter (see Fig. 65), by turning it downwards.
5. Remove the T&D sample inlet path (see Fig. 86, **5**).
6. Push the bypass cartridge (see Fig. 86, **8**) in the direction of the arrow (see Fig. 16) downwards.
7. Remove the bypass nipple (see Fig.5-3).
8. Press the securing button down with a screw driver (see Fig.5-3, **1**).
9. Gain access to the rear of the analyzer.
10. Disconnect the optical light guide from sample sensor SS2 from the bypass cartridge to the Mainboard.

Assembly is done in reverse order.

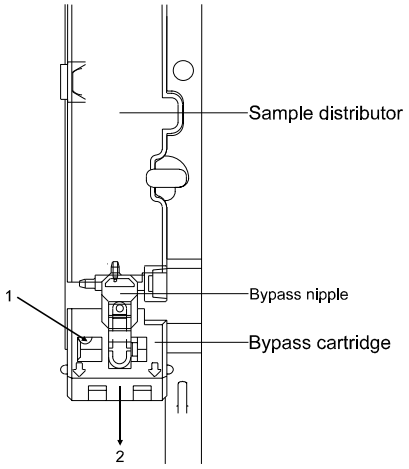


Fig. 16: Bypass cartridge

Changing the cable trees, flat cables, single cables and optical light guides

General information

When changing all cables, optical light guides or cable trees, switch off the AVL OMNI™ and follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components". Now you can change the defective cable. All cables and connecting points are labelled.
Please pay attention, that the exchanged cable is relocated in the same manner (cable holding clips).
Take notice that in the case of optical light guides, the white/black or black/white marked plug must be connected with its white/black counterpart.

Changing the cables BK0348, valve bus, DC-cable tree and cables which end at the Motherboard

When changing this cables, the fan unit must be removed. Follow the directions for "Changing the fan and the filter" (see page 5-30).

NOTE: *Remove the plug by pressing together lightly. When reconnecting the cable BK0348 (FMS) be sure to connect the plug precisely to avoid damage of the contact which could occur by changing.*

When changing the cable BK0348 (< SN 5000 BK0333) the FMS is to be removed also (see page 5-42, "Changing the FMS").

Container pipes

Function

The container pipes serve for fluid transportation.

Changing the container pipes

With the help of the shutdown tubing set, put the AVL OMNI™ out of operation (see Chapter 4 under "Shutdown") and follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".

Please pay attention which container pipes are to be changed according to Fig. 87.

Please proceed as follows:

Changing the container pipes for Solution 5, R1, R2 and R3 (Fig. 87, 8):

1. Remove the the Solutions 1 to 5 and the Reference solutions (R) from the bottle compartment.
2. Open the cover of the tubing (see Fig. 86, **18**), by pressing the two securing levers downward.
3. Pull off the corresponding tubes from the container pipes.
4. Gain access to the rear of the analyzer.
5. After loosening the corresponding fixing screw, the container pipe can be removed.

Changing the container pipes for Solution A, B, C, D and Mix (Fig. 87**, 15**, **13):**

1. Unscrew the right side panel (the screws are accessible from the inside).
2. Gain access to the rear of the analyzer.
3. Remove the 3 fixing screws for the PC tower (2 on the side panel, one on the bottom of the device) and pull out the PC tower approx. 70 mm in direction of the rear panel of the device.
4. After loosening the fixing screw, the container pipe **13** (Mix line, see Fig. 87) can be removed.
5. Please disconnect the connections for bottle A, B, C and D (see Fig. 86, **11**) for the removal of the container pipes for Solution A, B, C and D (see Fig. 87).
6. After loosening the corresponding fixing screws, the container pipes FL1, FL2, FL3 and /or FL4 (see Fig. 87) can be removed.

Assembly is done in reverse order.

NOTE: *The distance between the peak of the fill level sensor and the peak of the pipe has to be 8mm (± 0.2).*
If available use adjustment tool YB2022.

Fan and Filter

Function

The fan is responsible for the ventilation of the measuing chambers, the filter filters the aspirated air.

Changing the fan and the filter

When changing the fan and the filter (see Fig. 87, **4**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Open the Phillips screws on the back of the analyzer.
3. Remove the rear panel diagonally in the upward direction.
4. Remove the grounding plug from the rear panel.
5. Gain access to the rear of the analyzer.
6. Carefully remove the fan unit out a few centimeters, disconnect the supply cable of the fan unit from the Motherboard and remove the fan unit.

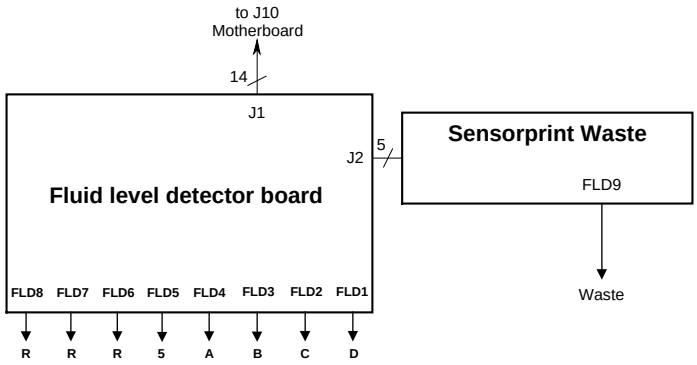
To change the filter it is not necessary to disassemble the housing of the fan.

Assembly is done in reverse order.

Fill level sensors - Waste cap with fill level detection

Function

- To check the reagent supply during measurement, calibration , test and operating procedures and
- cause the bottle changing picture on the display, if the bottle was connected.



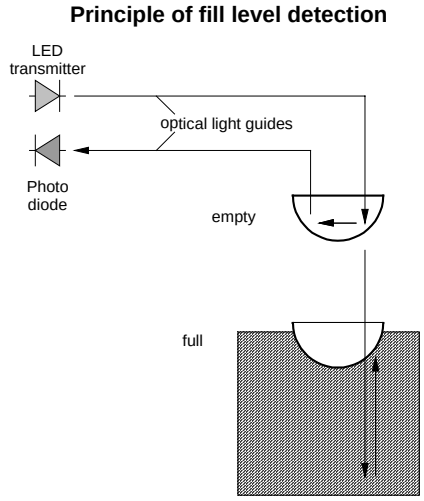


Fig. 17: Wiring - Filling level detection

The Fluid level detector board is located on the rear panel of the bottle compartment , behind the Waste container (see Fig.5-33, **9**).
The fill level control for reagents, Waste and Solution A are performed with the help of reflex light barriers with a reversing prism. A optical light guide leads from the light diode (LED) to the reversing prism and a further optical light guide from here to the photodiode. If the container is empty, a total reflexion of the boarder layers air / prism or prism /air results and the photodiode receives the light signal of the transmitter. If the container is full, a smaller reflexion takes place due to the almost identical calculation coefficient prism / water. Stray signals which are very small can be received at best.
The corresponding transmitter and receiver are soldered in a common plug housing on the printed circuit board. A duplex LWL-counterpart holds both

optical light guide, which lead to the fill level sensor, (represented by the reversing prism) which projects into the container.
All light source-(LED´s) are switched in series. The photodiodes have integrated amplifiers. The analog signals from the photodiodes are carried over the Motherboard (J10) to the Mainboard where they are then evaluated on the main control. The 8 signals FLD 1 - 8 are registered there by a multiplexer, the Waste signal FLD9 is evaluated separately.
To reduce effects from outside light, pulsed light in the infra-red range is used.

The following is differentiated in the AVL OMNI™:

- **Bottles with fill level detection (A, B, C, D, R1, R2, R3, W, 5):**
  After the barcode is scanned in, the insertion of the new bottle is identified by the fill level sensor and is transmitted over the main control to the PC (with the exception of Waste).
- **Bottles without fill level detection (Solution 1, 2, 3 and 4):**
  The input of the barcode is sufficient for the analyzer to recognize the bottle change.

Display of the filling levels

The display of filling levels on the screen takes place in the bottle changing picture (after opening the bottle compartment cover) and in the test program "**Options - Reagent Fill Levels**".
A counter with the corresponding filling level, is provided for each bottle. As a result of every action, the counter standing is reduced by a certain number. Every bottle with a fill level sensor possesses the following four significant conditions:

- FULL-Level
- SENSOR-Level
- WARNING-Level
- ALARM-Level

Alarm behaviors in containers with fill level detection

FULL level:

Corresponds to the counter standing after inserting a new bottle (scan in barcode and connect corresponding bottle.)

SENSOR level:

Corresponds to the counter standing where the fill level sensor can no longer detect a fluid. The actual counter standing is set at the "Sensor-Level-Counter" standing.
A counter, which has been reduced too quickly, must wait for the reaction of the sensor.
The optical/electrical fill level control only synchronizes the counting process of the respective bottle (counter synchronization).
If a fill level sensor reports a FULL bottle at a counter standing < SENSOR level, the counter is set on the SENSOR level. The color of the bottle-changing picture remains blue.

WARNING level:

At this level, the fill level sensor can not identify any fluid at all. The counter standing is reduced further and "**Check Fill Levels**" appears in the message window.
The rest volume is shown in the cyan color in the bottle-changing picture and the analyzer operation can proceed without any restrictions.
Simultaneously, the corresponding bottles are synchronized. In other words, the counter standing is set at the WARNING level and is marked with SYNC (bottle synchronization).

ALARM level:

When the ALARM level is reached, the performance of the next necessary action is no longer possible however the measuring chambers are still filled and the analyzer goes into "**Fill Stop**". The "**Fill Stop**" process can be terminated by opening the bottle compartment cover or by pressing the "**System**" -key. The alarmed bottles are displayed in red (crossed-out) in the bottle-changing picture (after opening the bottle compartment cover).
Simultaneously, the counter standing of the corresponding bottle is set on the ALARM level and the bottle symbol is shown in red (crossed-out).

A counter reduction does not occur when:

- the counter is in the SYNC status (bottle synchronization).
- the counter standing is smaller / equal to the SENSOR level and the fill level sensor identifies the bottle as FULL.

Alarm behavior in containers without fill level detection

The synchronization procedures are omitted by the optical/electrical fill level detection in these reagents.
When the ALARM level is reached no **Fill Stop** is given, but:

Solution 1 and 3 (solution for calibration of MSS):

Releasing of a "**Check MSS Solutions**", which means that MSS parameters will be no longer calibrated, when "**MSS: No Sample Detect**" is detected by the sample sensor SS2 in addition.

Solution 2 (Na-contitioner):

Releasing of a **No Cond. Sol.**, which means the Na electrode is warned with Flag=31 (not_calibrated_condi), when "NO SAMPLE" is detected by SS2 in addition.

Solution 4 (PO_2-zero solution):

- Releasing of a "**Check Solution 4 !**", which means the PO_2 electrode is warned with Flag=32 (not_calibrated_O2zero), when "**No Sample**" is detected by the sample sensor SS2 in addition.
- Releasing of a "**Sol 4 exhausted!**", which means the PO_2 electrode is warned with Flag=32 (not_calibrated_O2zero), when the measured pH-value of PO_2-zero solution is < 5.

Synchronization

The following reagents are synchronized:

- Bottle **B** and **C**

Only full bottles are synchronized (fill level sensor detects FULL).
If the WARNING level is not reached by one of the bottles to be synchronized:

- The counter of both bottles is set at the WARNING level
- the counter of bottle B or C is marked with SYNC
- the message "**Check Fill Levels**" is shown on the screen and
- the contents of the bottles on the bottle changing picture corresponds with the counter standing and are shown in the cyan color

Only one bottle can show the SYNC condition.

If a counter is marked with SYNC it will not be reduced further.

The bottle synchronization is cancelled when:

- the bottle which caused the SYNC detects a BOTTLE FULL with the fill level sensor
- the fill level sensor of the bottle which was synchronized, detects EMPTY
- this bottle was changed (in the bottle changing picture)

After canceling a bottle synchronization:

- the counter is set at the SENSOR level and reduced further when the respective fill level sensor detects FULL, or
- when the respective fill level sensor detects EMPTY and the counter is set at the WARNING level, reduced further and it simultaneously gives the SYNC status further to the twin bottle (B or C).

If a bottle to be synchronized reaches its ALARM level, a FILL STOP is given and both bottles are shown in red (crossed-out) in the bottle changing picture.

General rules for opto-electrical fill level detection

The initial scanning in of the fill level takes approx. 30 ms.

The fill level control is activated:

- **during emptying of the sample distributor**

– The following is applicable for Waste:
In a time window of approx. 4.5 seconds (0.5 seconds after the vacuum pump has stopped, until the end of Wait BG3) permanent scanning in takes place. If the filling level is detected as "empty" once during this time, it is interpreted as being not "full" yet.

– For the other containers:
Scan in the fill level sensors value and interpret.

- **in bottle changing picture**

– the following is applicable for Waste:
Only changes from "full" to "empty" are detected (scan in once = result).

– For the other containers:
A change in fill level is detected after the same condition has been scanned in after 15 times (the value is actualized approx. every 0.5 seconds).

- in the test program "**System - Test - Component Test - Sensors - Fill Level Sensors**".

  Permanent scanning in every 30 ms and actualization of the voltage values every second.

  Border values: > 500 mV is the same as bottle EMPTY

  Lightness value + 50 mV > Dark value = o.k., otherwise, FLUID LEVEL SENSOR ERROR (SYS. STOP).
  If this error occurs, the artificial value of 5396 mV, or 1 mV for Waste is shown in the test program "**Fill Level Sensors**".

  Dark value greater than 4000 mV also gives a FLUID LEVEL SENSOR ERROR (SYS. STOP).
  If this error occurs, the artificial value of 5000 mV, or 0 mV for Waste is shown in the test program "**Fill Level Sensors**".

Following actions to bottle change

A vacuum test takes place in any case, after closing the bottle compartment cover.

In addition:

- When bottle 1, 2, 3, 4, 5, A, B, C or D was changed an **aspiration** of the solution is performed.
- Additional when bottle C and D was changed a **calibration of the mixing system** is performed.
- When R1, R2 and/or R3 are changed a **filling of the Reference electrode** is performed.

Subsequently, all necessary calibrations will be performed.

Signal strobing

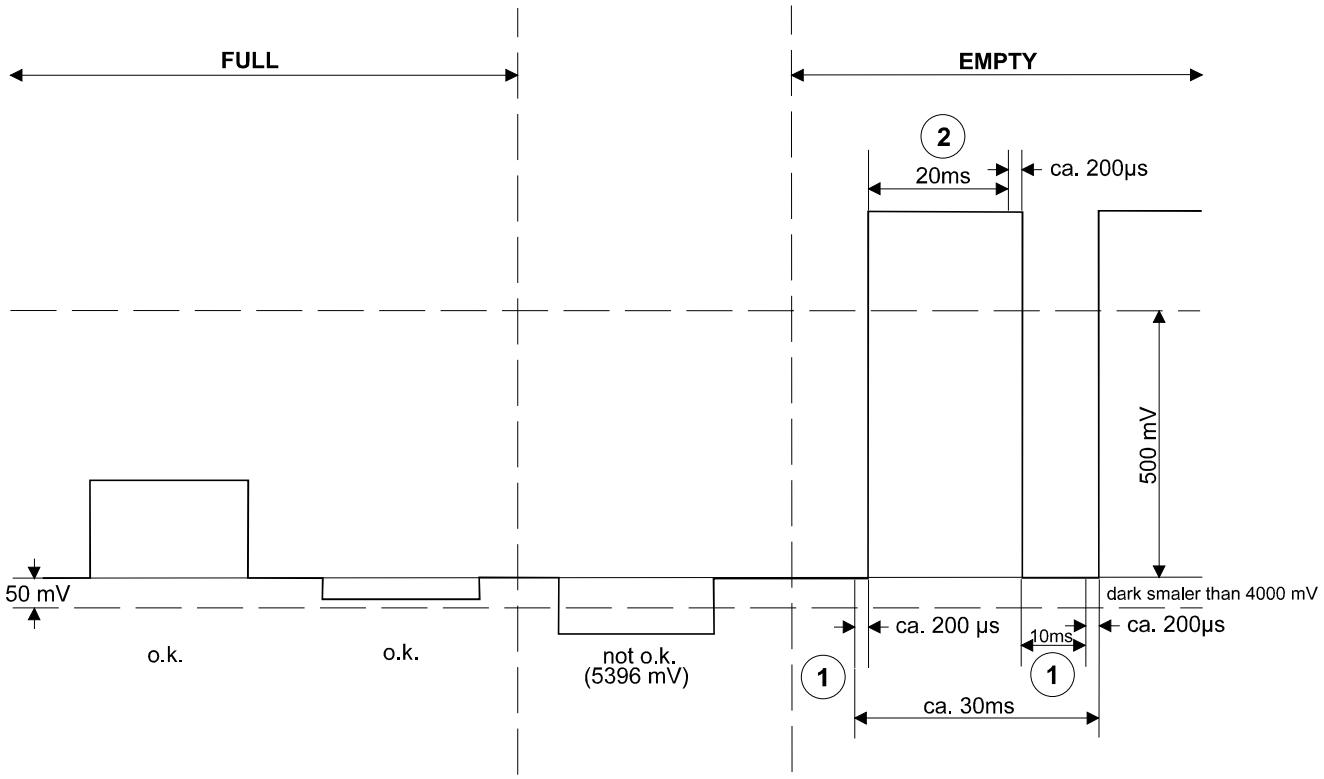


Fig. 18: Strobing

Border values

First point in time: After 10 ms during "light off" the scanning in of all fill level sensors and the question if the dark value is < 4000 mV is performed. If this is not the case, a Fill error (SYSTEM STOP) is given. In the test program the "**System - Test - Component Test - Sensors - Fill Level Sensors**" the artificial value of 5000 mV or 0mV for Waste is shown.

Second point in time: After "Light on" and a waiting time of 20 ms, the scanning in of the lightness value takes place.

The difference between the lightness value and the darkness value must be > 500 mV so that the sensor can detect "empty".
The difference between the lightness value and the darkness value must be < 500 mV but > -50 mV so that the sensor can detect "full".
If the difference is < - 50 mV a Fill error (SYSTEM STOP) is given. In the test program "**System - Test - Component Test - Sensors - Fill Level Sensors**". The artificial value of 5396 mV is shown.
Differences between 0 and -49 mV are shown as Diff = 0 mV.

Changing the fill level sensors

With the help of the shutdown tubing set, put the AVL OMNI™ out of operation (see chapter 4 under "Shutdown") and follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".

Please pay attention which fill level sensors are to be changed according to Fig. 87.

When changing the fill level sensors, please proceed as follows:

Changing the fill level sensors FL5, FL6, FL7 and FL8 (Fig. 87):

1. Remove the Reference solutions (R) from the bottle compartment.
2. Remove the REF seal.
3. Grip the fill level sensor and turn them +90° or -90° using the tool VD0229 or pointed pliers.
4. Disconnect the corresponding sensor from the Fluid level detector board (see Fig. 87, **11**) and remove through the front.

NOTE: *Be careful that the tip of the new fill level sensor is not damaged.*

Assembly is done in reverse order.

Changing the fill level sensors FL1, FL2, FL3 and FL4 (Fig. 87):

1. Unscrew the right side panel (the screws are accessible from the inside).
2. Gain access to the rear of the analyzer.
3. Remove the 3 fixing screws for the PC tower (2 on the side panel, one on the bottom of the device) and pull out the PC tower approx. 70 mm in direction of the rear panel of the device.
4. Grip the fill level sensor and turn them +90° or -90° using the tool VD0229 or pointed pliers.
5. Disconnect the corresponding sensor from the Fluid level detector board (see Fig. 87, **11**) and remove through the front.

NOTE: *Be careful that the tip of the new fill level sensor is not damaged.*

Assembly is done in reverse order.

Changing the Fluid level detector board

Electrostatic Sensitive Device

When changing the Fluid level detector board (see Fig. 87, **9**), please proceed as follows:

1. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
2. Gain access to the rear of the analyzer.
3. Disconnect all cables and optical light guides from the Fluid level detector board.
4. Unscrew the four Phillips screws.

Assembly is done in reverse order.

Changing the Waste cap T2

When changing the Waste cap T2 (see Fig. 86, **22**), please proceed as follows::

1. Open the analyzer cover and remove it, in the upward direction.
2. Open the bottle compartment cover.
3. Pull off both tubes from the Waste cap T2.
4. Swing out the Waste container and pull container down and out.
5. The Waste cap T2 can be removed by pressing both flaps together.

NOTE: *The Waste container and its tubing may contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin.*
Use rubber gloves.

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Assembly is done in reverse order.

Activate the function "**Options - Wash**".

Changing the Waste cap completely

When changing the Waste cap completely, please proceed as follows:

1. Shutdown the AVL OMNI™ with the help of the shutdown tubing set (see chapter 4 under "Shutdown").
2. Follow steps 1. to 11. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Pull off both tubes from the Waste cap T2.
4. Lift up the Waste container and pull out towards the bottom.
5. The Waste cap T2 can be removed by pressing together the two flaps.
6. Gain access to the rear of the analyzer.
7. Remove the flat cable from the Fluid level detector board (Fig. 87, **11**).
8. Pull off the silicone tube from the Waste cap complete at the T-piece.
9. Press both holders of the Waste cap complete apart and remove these.

Assembly is done in reverse order.

Fluid mixing system (FMS)

Function

The AVL OMNI™ uses a novel approach for the simultaneous calibration of PCO_2, pH, Na^+, K^+, iCa^{++} and Cl^- sensors, using only two reagents.
This eliminates the use of any gas supply system and thus eliminating all disadvantages coupled with gas supplies (space occupied, security risk, additional handling).
The approach is based on a known and simple chemical reaction.
To achieve a specific PCO_2 pressure, pH value and ion content in the calibration solution, two solutions (B and C) will be mixed in a special proportion via a special fluid mixing system (FMS).
The technology doesn't call for extreme precision because the aspiration ratio for calibrators B and C will be determined from the conductivity measurement in the measuring chambers. Knowing the actual mixing ratio, PCO_2, the pH value and the concentration of the different analytes are calculated using known chemical and mathematical formulas.
The conductivity measurement is calibrated exactly by using the pure calibration solutions B and C. There is no systematic difference in the calibration results between the prior art method and this method.
Solution B contains carbonate, bicarbonate and electrolytes. Solution C contains acids, pH buffer and electrolytes.
The chemical nature of the solutions and the choice of the concentration of their components make these solutions insensible to exposure to ambient air during shelf storage and in-use storage, any influence being negligible for the quality of calibration.

Changing the FMS

When changing the FMS (see Fig. 86, **9**), please proceed as follows:

1. Turn the AVL OMNI™ off.
2. Follow steps 1. to 11. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components" (applicable for devices with a SN>5000 only).
3. Open the bottle compartment cover.
4. Remove the bottles B, C and D from the bottle compartment.
5. Remove the tubing from the FMS.
6. Unscrew the 4 Phillips screws.
7. To prevent damage of the two valve cables on the rear of the FMS, please remove carefully.
8. Disconnect both valve cables.

NOTE: *Do not use a sharp edged pair of tweezers to remove the tubing.*

Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Assembly is done in reverse order.

Test the function of the valves V19 and Mixing valve (Mix) in the menu "**System - Test - Component Test - Valve Test**".

Changing the FMS air bubble trap

When changing the FMS air bubble trap, (see Fig. 55) remove the sample distributor cartridge. Follow the directions "Changing the sample distributor cartridge" (see page 5-122).

1. After disassembling the sample distributor cartridge, move the FMS air bubble trap back to normal position.
2. Remove the FMS air bubble trap in the upward direction.

NOTE: *Be sure the FMS air bubble trap sits firmly when reassembling.*

Hemolyzer

(applicable from SN 5000 on; for SN < 5000, see chapter 10, Manual revision 8.0)

Function

Before the actual measurement, the erythrocytes are destroyed with an ultrasonic hemolyzer to allow measurement of a homogeneous colored solution.

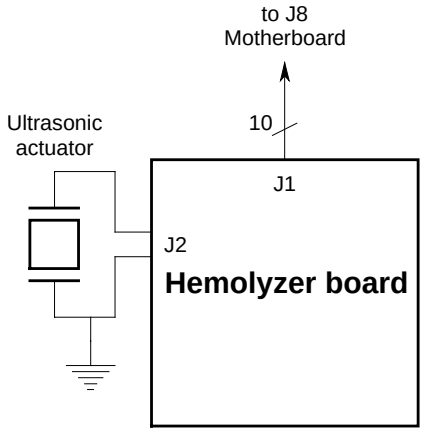


Fig. 19: Hemolyzer (1)

The hemolyzer consists of a resonator as well as the respective control (Hemolyzer board). The power supply for the quartz resonator is generated on this board. The activation takes place on the Mainboard. Full hemolyzer power will be switched on 25ms after sample contact (detected by the hemolyzer circuit).

Changing the hemolyzer

When changing the hemolyzer, please proceed as follows:

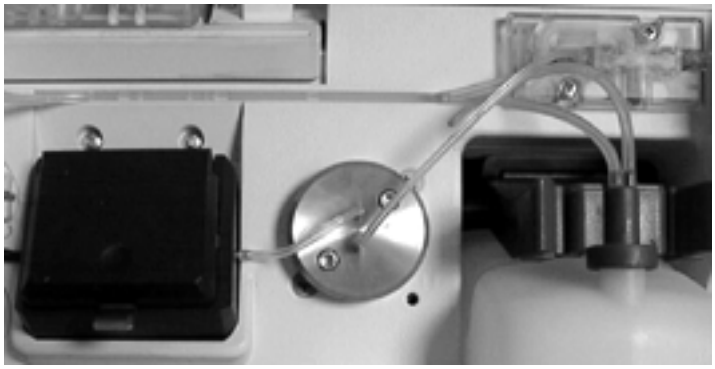


Fig. 20: Hemolyzer (2)

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Pull off the tubes from the hemolyzer.
4. Remove the cover of the hemolyzer by unscrewing the Allan head screws.
5. Gain access to the rear of the analyzer.
   Unplug **J8** from the Motherboard (see Fig. 44).
6. Disconnect the grounding from the hemolyzer.
7. In order to remove the hemolyzer from the analyzer, loosen both Phillips screws on the front of the analyzer.

Assembly is done in reverse order.

NOTE: *When assembling the hemolyzer, the securing screws are to be tightened alternately to prevent canting.*

Do not exchange the two tubes on the hemolyzer when reconnecting.

Mainboard

Function

A detailed description of Mainboard functions can be found in Chapter 3 "Description of functions / Specifications".

Changing the Mainboard

Electrostatic Sensitive Device

When changing the Mainboard, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Open the Phillips screws on the back of the analyzer.
3. Remove the rear panel diagonally in the upward direction.
4. Remove the grounding plug from the rear panel.
5. Disconnect all cables and optical light guides from the Mainboard.
6. Press down both ejection flaps (see Fig. 87, **3**), the printed circuit board is pushed out a little from the top, and can be removed easily.

Assembly is done in reverse order.

NOTE: *After changing the Mainboard, the barometer sensor is to be reset (see chapter 8, "Service Area - Setup - BP Set").*

Description of the DIL switch and LED's on the Mainboard

(Applicable from software revision number >4.5)

The following description is valid from the hardware version Rev.25 and from the software version HS 2.427, MM 2.412.

NOTE: *All switches are to be set at **OFF**(with the exception of switch 7) for normal operation.*

Main control HS (left row, seen from the rear):

Rocker switch 1	OFF	µC- ON-CHIP-EMULATION-MODE (deactivated)
2	---	not used
3	---	not used
4	OFF	not used
5	OFF	not used
6	ON	burn-in test (deactivated)
7	ON	valves equipped with linear actuators
8	OFF	not used

Measuring module control MM (right row, seen from the rear):

Rocker switch 1	OFF	not used
2	---	not used
3	ON	Cl/K amplifier interchanged
4	ON	short warm up after power on
5	---	not used
6	---	not used
7	OFF	OMNI tester - switch test (deactivated)
8	OFF	OMNI tester - switch test (deactivated)

Main control HS (left row, seen from the rear, LED 1 is on the left):

LED	1	Reset	should only light up briefly when turning on
	2	Optobus transmitter HS	lights slightly („glimmers“) *
	3	Optobus receiver HS	*
	4	Optobus transmitter MM	*
	5	IRQ HS for Opto RS232	blinks similarly to the large LED’s on the left
	6	NMI (RISM) HS	only for R&D tests; normal dark
	7	IRQ chart recorder MM	only for R&D tests; is always blinking
	8	NMI (RISM) MM	only for R&D tests; normal dark

Measuring module control MM (right row, seen from the rear):

LED	1	Temperature regulator BG MM	#
	2	Temperature regulator ISE MM	#
	3	Temperature regulator MSS MM	#
	4	+24 V tHb module supply	temperature fuse
	5	Temperature regulator SD	#
	6	Power supply + 5 V	must always light up
	7	Power supply +/- 12 V	must always light up
	8	Power supply + 24 V	must always light up

are only active when the corresponding measuring chamber is assembled. The intensity is dependent upon the heating energy heater current. Therefore, they light up intensively during the warm-up procedure, thereafter, only glimmer. When the respective module is cooled down, the LED must light brighter for a short time.

Barometer sensor

The barometric pressure is continuously measured with a piezoelectric pressure sensor located on the Mainboard. The measured barometric pressure is required for the correct display of the measured oxygen partial pressure and/or for the 1P calibration value of the oxygen partial pressure. The sensor is factory-calibrated by the manufacturer. No further maintenance or calibration is required.

Components location

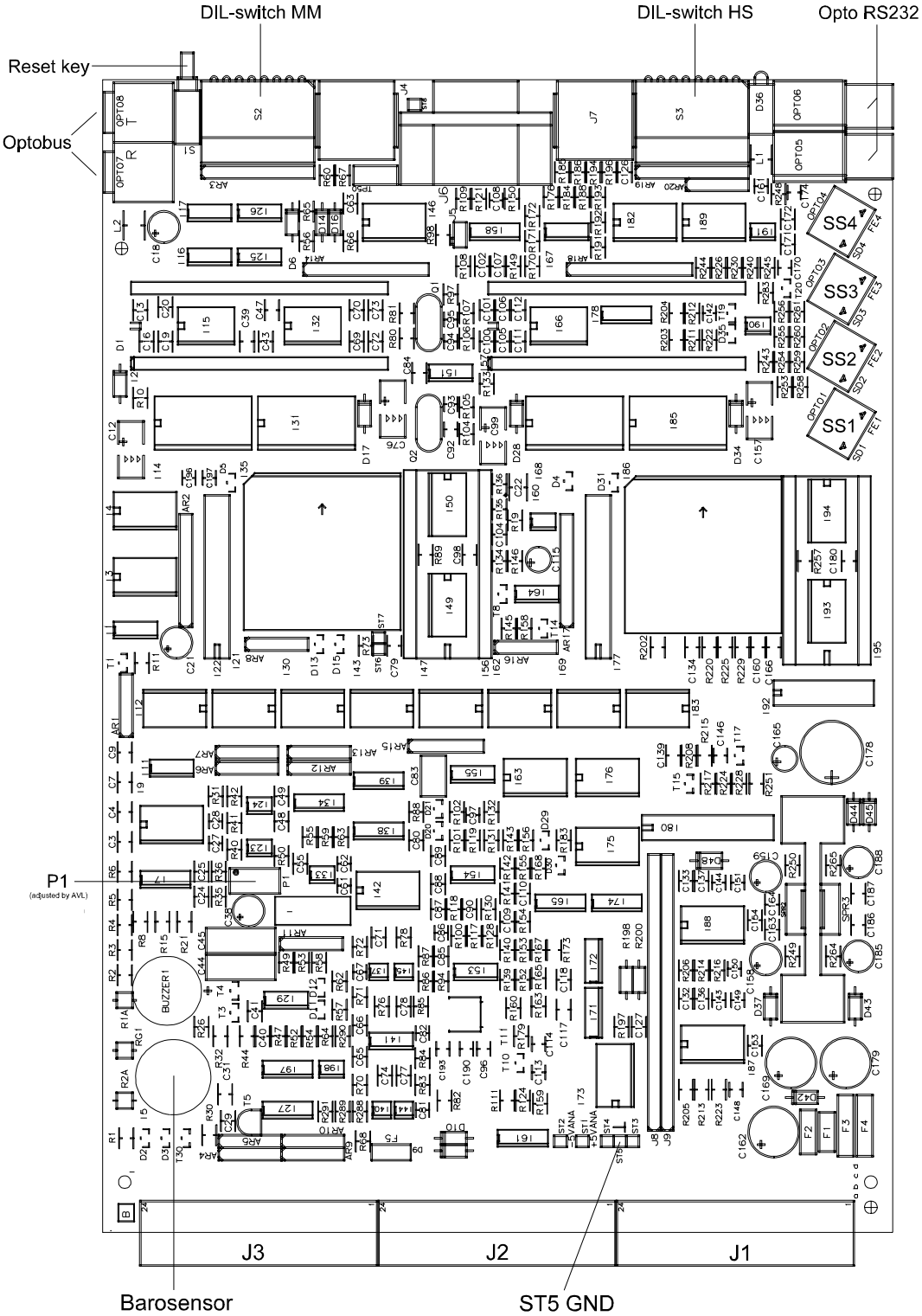


Fig. 21: Mainboard

Measuring chambers

Blood gas (BG) measuring chamber

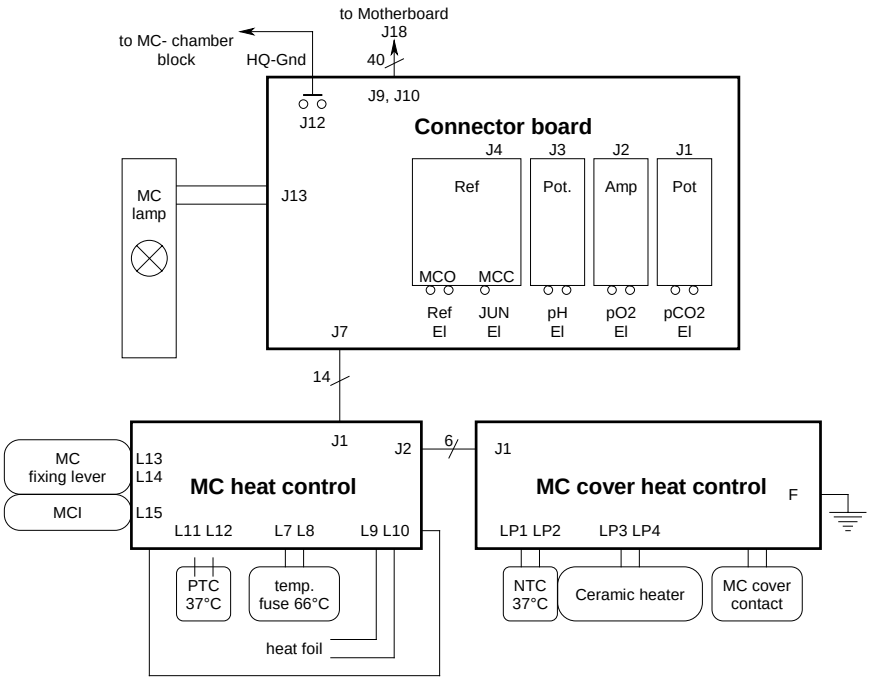


Fig. 22: Wiring - BG measuring chamber

Function

The BG measuring chamber consists of a two-piece measuring chamber block (measuring chamber tub and cover). Both parts are thermostated. The Connector board, which also serves as a carrier printed circuit board for the electrode amplifier and the lighting, is assembled on the measuring chamber tub.
The electrode amplifiers are finished as small modules and are soldered in the Connector board. Three different types of amplifiers are provided:

- an amperometric amplifier for the PO_2 channel,
- a potentiometric amplifier for the PCO_2 channel and
- a reference amplifier for the Reference electrode and the Junction.

The amplifiers supply already digitalized output signals, which are transmitted to the measuring module control.
Spring contacts on the single amplifiers serve for the contacting of the single (flow-through) electrodes, which are inserted in the measuring chamber tub.
A light foil for the lighting of the measuring chamber is also located in the measuring chamber tub, which is connected on J13 on the Connector board. The power supply for this foil is generated from the Connector board (140 V_{eff} ~).
The heating foil and heating control with the temperature sensors and the temperature fuse are located on the bottom of the measuring chamber tub. The contacts L7 to L15 are soldering connections on the heating control.

The cover heating control with a ceramic heating element and heating transistors with a corresponding NTC temperature sensor is located in the measuring chamber cover with the viewing window.
A hall sensor identifies the opening of the cover and is connected to the cover heating control.
The steering and supply takes place over a 2x20-poled flat cable from the Motherboard (J18).

Fluid detection in the measuring chamber and conductance measurement

A MCI contact (see Tubing diagram, chapter 7, "Functional procedures"), is located at the entrance of the measuring chamber (in the tube path) and a further one in the Junction (MCC, is connected to the reference amplifier). A third contact is located in the Reference electrode (MCO, also connected to the reference amplifier). A very exact conductance measurement is made during calibration, between the contacts MCI and MCC. Herewith, the conductance of the single solutions and the exact mixing proportions can be determined.
The control of the fluid aspiration into the measuring chamber is also performed with the help of conductance measurement, with the contacts MCI to MCO or MCI to MCC. In this case the measurement is performed faster, however with less accuracy.

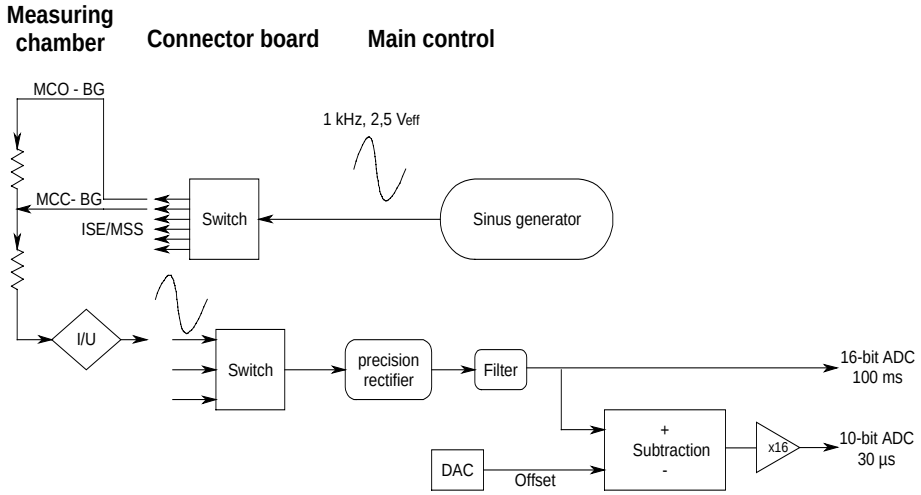


Fig. 23: Basic circuit - conductance measurement

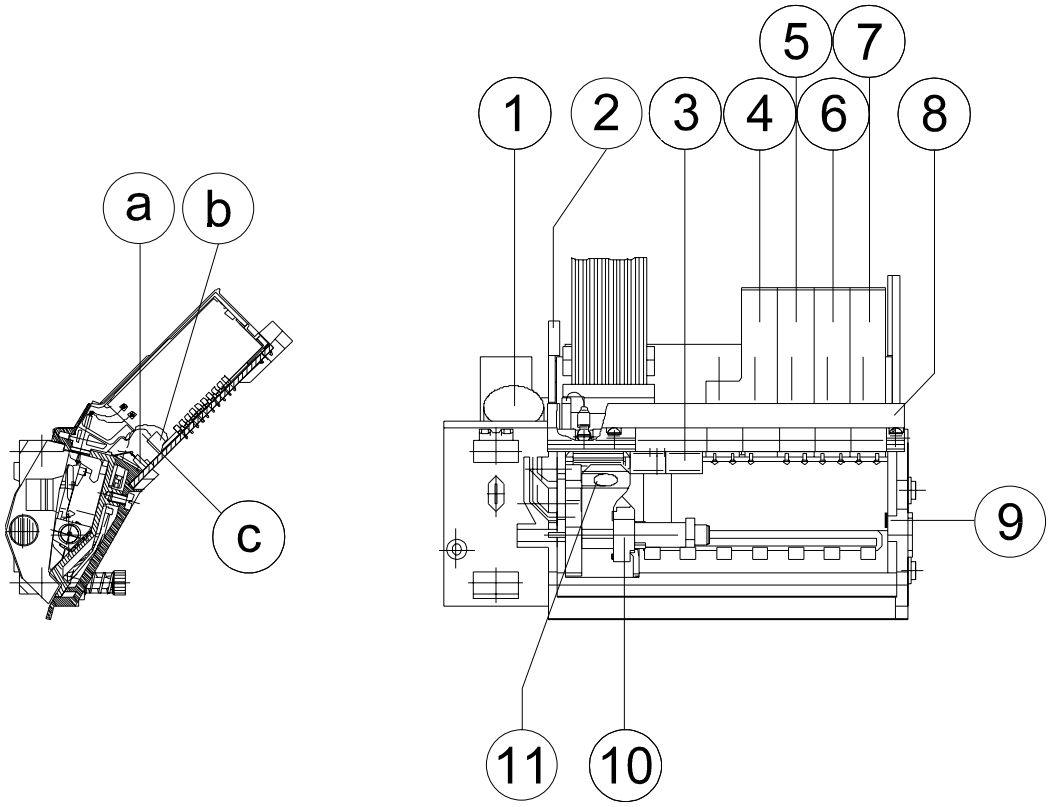


Fig. 24: BG measuring chamber

(1)	.....	Connector board
(2)	.....	Leg
(3)	.....	Dummy electrode housing
(4)	.....	Amplifier REF 9700LP3
(5)	.....	Amplifier POT 9700LP1
(6)	.....	Amplifier AMP 9700LP2
(7)	.....	Amplifier POT 9700LP1
(8)	.....	BG measuring chamber ledge
(9)	.....	center seal for MC
(10)	.....	MC electrode holder BG
(11)	.....	Locking lever
(a)	.....	Connector for MC illumination foil
(b)	.....	Connector for measuring chamber heating
(c)	.....	14-poled flex cable

Changing the BG measuring chamber

Electrostatic Sensitive Device

When changing the BG measuring chamber (see Fig. 86, **23**), please proceed as follows:

1. Shutdown the AVL OMNI™ with the help of the shutdown tubing set (see Chapter 4 under "Shutdown").
2. Open the analyzer cover and remove in an upward direction.
3. Disconnect the two electrode plugs (black and white, see Fig. 32).
4. To open the measuring chamber, press the measuring chamber cover gently to the left.
5. Open the locking lever (see Fig. 24, **11**) and pull off the MC output tube.
6. Remove the electrodes and close the measuring chamber cover.
7. Follow the steps 2. to 10. on page 5-2 under „General information on assembly and disassembly of components“.
8. Remove the SD cartridge as described on page 5-122 (starting with item 5).
9. Remove the fastening screws for the BG measuring chamber (2 on the side of the sample distributor and 1 Phillips screw left, next to the measuring chamber).
10. Gain access to the rear of the analyzer.
11. Disconnect the cable of the measuring chamber at the Motherboard.
12. Pull the measuring chamber out of the locking to the left and then down and out.

Assembly is done in reverse order.

NOTE: *The polarization voltage is to be reset after changing the entire BG measuring module, the Connector board with the PO_2 - amplifier or the PO_2-amplifier alone (see chapter 8, "Service Area - Setup - O2 UPol").*

ISE measuring chamber (AVL OMNI™ 4 to 9)

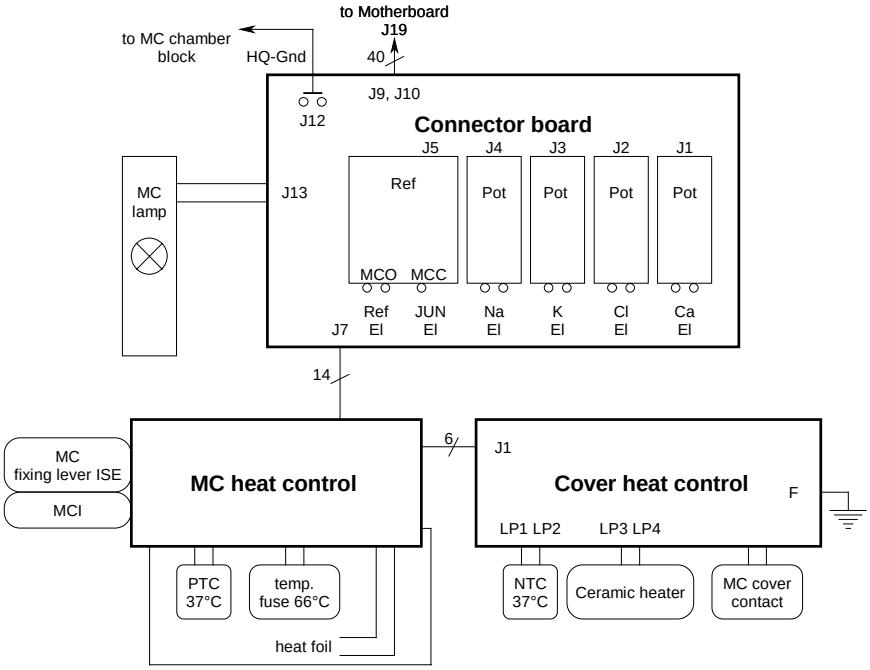


Fig. 25: Wiring - ISE measuring chamber

Function

The ISE measuring chamber only differs from the BG measuring chamber (see page 5-49) in the equipping of the amplifier on the Connector board. A potentiometric amplifier as well as a common reference amplifier are given for all ISE electrodes. Steering and supply take place over the Motherboard J19.

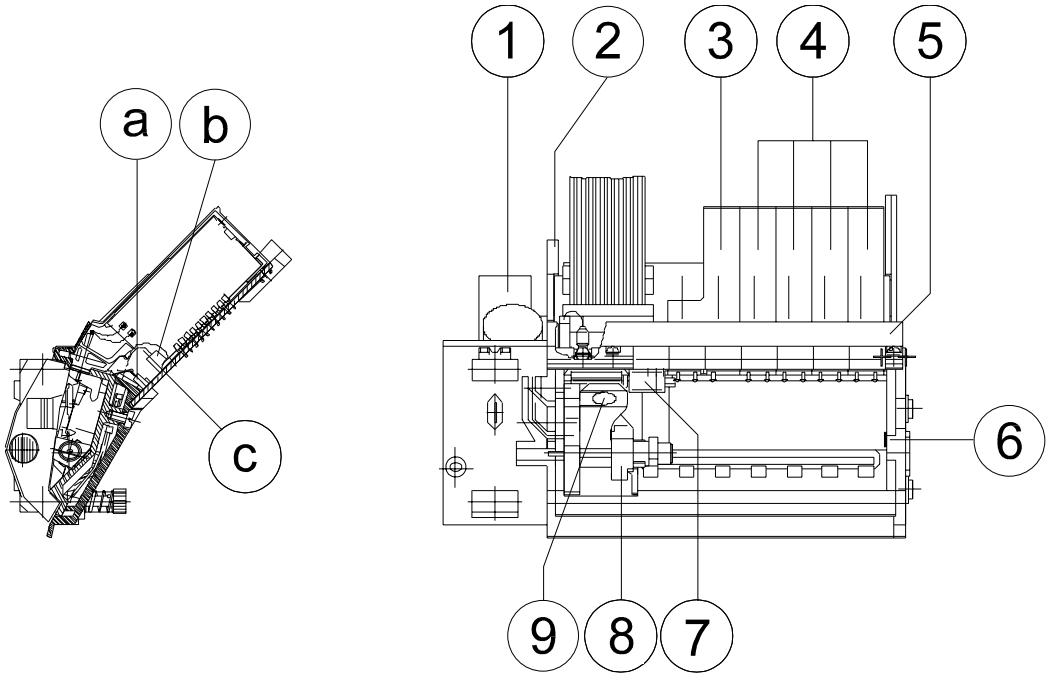


Fig. 26: ISE-measuring chamber

(1)	.....	Connector board
(2)	.....	Leg
(3)	.....	Amplifier REF 9700LP3
(4)	.....	Amplifier POT 9700LP1
(5)	.....	ISE measuring chamber ledge
(6)	.....	Center seal for MC
(7)	.....	Dummy electrode housing
(8)	.....	MC electrode holder ISE
(9)	.....	Locking lever
(a)	.....	Connector for MC illumination foil
(b)	.....	Connector for measuring chamber heating
(c)	.....	14-poled flex cable

Changing the ISE measuring chamber

Electrostatic Sensitive Device

When changing the ISE measuring chamber (see Fig. 86, **24**), please proceed as follows:

1. To disassemble the ISE measuring chamber, first remove the BG measuring chamber. Follow the instructions on page 5-52 under "Changing the BG measuring chamber".
2. Disconnect the two electrode plugs (black and white, see Fig. 32).
3. To open the measuring chamber, press the measuring chamber cover gently to the left.
4. Open the locking lever (see Fig. 26, **9**) and pull off the MC output tube.
5. Remove the electrodes and close the measuring chamber cover.
6. Remove the cover of the MSS measuring chamber by opening the Phillips screw (AVL OMNI™ 1 to 6).
7. Remove the fastening screws for the ISE measuring chamber (2 on the side of the sample distributor and 1 screw, left, next to the measuring chamber).
8. Remove the measuring chamber cartridge (see page Fig. 32), when the analyzer still has a measuring chamber cartridge, which does not have space for the measuring chamber output tubes.
9. Gain access to the rear of the analyzer.
10. Disconnect the cable of the measuring chamber at the Motherboard.
11. Pull the measuring chamber out of the locking to the left and then down and out.

Assembly is done in reverse order.

NOTE: *Before replacing the electrode plugs clean their coupling piece on the measuring chamber with cotton swab.*

MSS measuring chamber (AVL OMNI™ 7, 8 and 9)

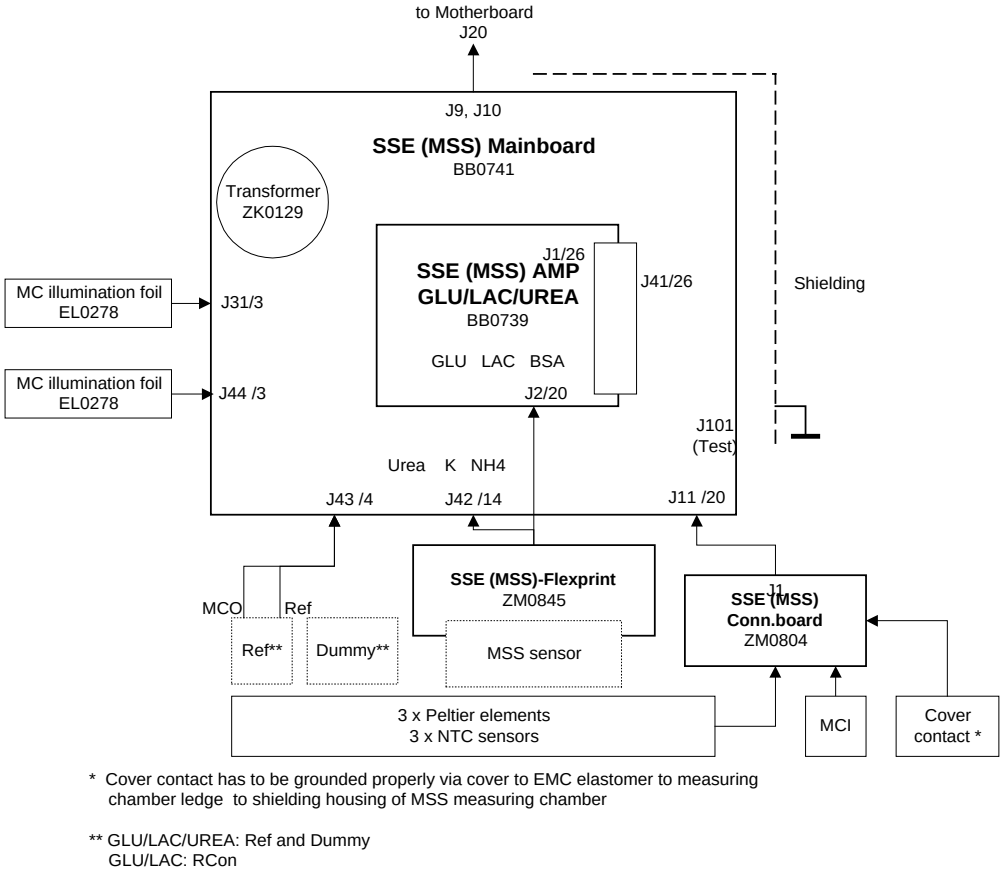


Fig. 27: Wiring - MSS measuring chamber

Function

The MSS measuring chamber is used for measuring glucose, lactate and urea and consists of a measuring chamber for the MSS cassette (multiparameter sensor), the **RCon** (reference contact electrode for glucose and lactate) or a **reference electrode** and a **dummy electrode** (for glucose, lactate and urea) and the associated control and diagnostic electronics.
The measuring chamber is thermostated to 25 °C or 30 °C (adjustable) with the aid of Peltier elements (cooling and heating is necessary because of the specified ambient temperature range of 15 - 31 °C).
For this temperature regulation, 3 Peltier elements with one NTC each are used as temperature sensors.
Contact between the MSS cassette and the two amplifier boards is established with the aid of the contact clip via a flexible PCB. Contact for the **RCon** or the **reference electrode** and the **dummy electrode** is established conventionally via push pins.

The SSE (MSS) Mainboard contains the following:

- potentiometric amplifiers for Urea, NH4 and K (NH4 and K are necessary for correction),
- reference amplifiers,

- temperature regulation circuits for the Peltier elements,
- temperature measurement amplifier for electrode holder temperature (measuring chamber temperature) and contact clip temperature and
- Diagnostic circuit for conductivity measurement (with the aid of contacts MCI, MCO and Ref).

SSE (MSS) Amp Glu/Lac board contains:

- a DC/AC-converter to supply the measuring chamber illumination strips,
- a measuring chamber cover contact signaling whether the cover is open,
- amperometric amplifier units for the glucose-, lactate- and BSA- amplifier.

The SSE (MSS) Amp Glu/Lac board is directly plugged onto the SSE (MSS) Mainboard.
The MSS cassette has for glucose, lactate and BSA 3 connectors each, the working electrode, the reference electrode and the counter electrode. The sensors are controlled in an electric circuit, which sets the voltage of the reference electrode at -350 mV compared to the working electrode. The voltage at the counter electrode is varied to keep the voltage at the reference electrode constant. The current flowing into the working electrode is evaluated as the measurement signal. The BSA signal is used as corrective value for the glucose and lactate measurement value.

Urea, NH4 and K, each have a connection to a potentiometric amplifier to measure the voltage against the reference electrode and to evaluate it as measurement signal.
NH4- and K - signal are used as correction signals for urea.

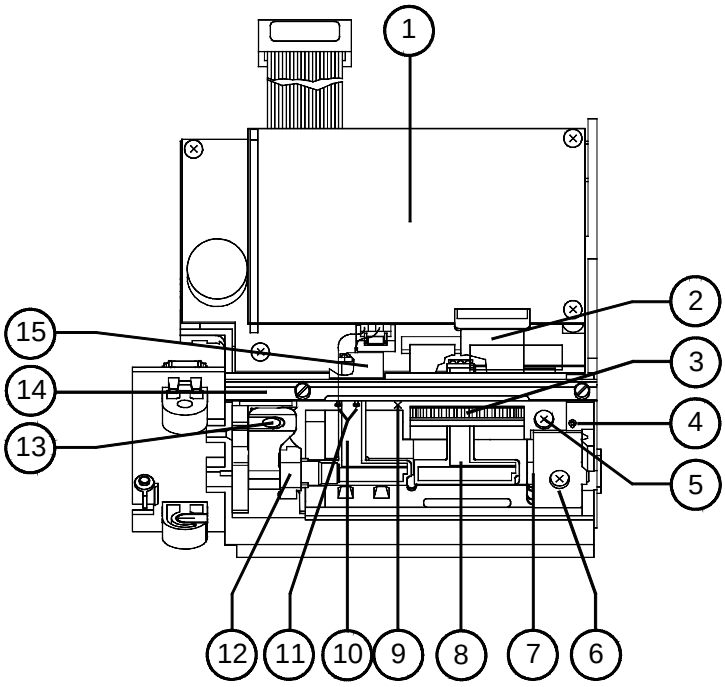


Fig. 28: MSS measuring chamber (1)

(1)	SSE (MSS) Amp Glu/Lac board and SSE (MSS) Mainboard
(2)	Contact foil
(3)	+ Carrier plate
(4)	Push pin (cover contact)
(5)	Clamping block
(6)	Cooling block
(7)	Center seal for MC
(8), (10)	MC illumination foil
(9)	Fastening screw for clamping block
(11)	Push pins
(12)	MC electrode holder MSS
(13)	Locking lever
(14)	MSS measuring chamber ledge
(15)	Amplifier module

Changing the MSS measuring chamber

Electrostatic Sensitive Device

When changing the MSS measuring chamber (see Fig. 86, **26**), please proceed as follows:

1. With the help of the shutdown tubing set, put the AVL OMNI™ out of operation (see Chapter 4 under "Shutdown").
2. Follow the steps 1. to 10. on page 5-2 under „General information on assembly and disassembly of components“.
3. Open up the PP cover.
4. Pull sample drip tray down and out (see Fig. 56, **6**).
5. Remove the fill port adapter (see Fig. 56, **5**) by turning it downwards.
6. Remove the T&D cover by pressing the lower edges in an upward direction and pull it off toward the top.
7. Remove the sample inlet path (see Fig. 56, **4**).
8. Push the bypass cartridge (see Fig. 56, **b**) in the direction of the arrow downwards and remove the bypass nipple (see Fig. 56, **a**).
9. Pivot the FMS air bubble trap (see Fig. 56, **3**) towards the right outside.

NOTE: *Make sure that the FMS air bubble trap is fully swiveled out to make the nipple accessible.*

10. Pull off the tube (see Fig. 56, **1**) from the sample distributor and the SD cartridge.

NOTE: *Be careful when removing and attaching the tubing at the upper nipple to V15.*
Do not use a sharp-edged pair of tweezers to pull off the tube.

11. Release the SD cartridge by turning the 3 holding levers (see Fig. 56, **2**) 90° to the left.
12. Lift the SD cartridge on the right upper end and rotate outwards.
13. Disconnect the electrode plugs (black and white, see Fig. 32) from the MC cartridge.
14. Gain access to the rear of the analyzer.
15. Disconnect the flat cable of the MSS module from the Motherboard and the ground cable.
16. Open the following screws:
    - Holding screw for the sample distributor (see Fig. 56, **7**)
    - screw on the left side of each measuring chamber
    - screw on the side of the sample distributor (Fig. 56, **c**)
17. Swivel the sample distributor block/measuring chamber unit carefully out of the AVL OMNI™ and remove the MSS measuring chamber by unscrewing the 2 hexagonal screws on the side of the measuring chamber.
18. Remove the MSS module.

Assembly is done in reverse order.

NOTE: *Make sure that the L-elastomer (top right on the SD cartridge) is placed properly on the sample distributor when reassembling the SD cartridge.*

Do not exchange the two tubes on the sample distributor when reconnecting.
Before replacing the electrode plugs clean their coupling piece on the measuring chamber with cotton swab.

Finally

1. Remove the **RCon** (or the **reference**- and the **dummy electrode**) and MSS cassette from the old measuring chamber and install the new unit.
2. Switch on the AVL OMNI™.
3. Activate "**System - Util - Analyzer Actions - Fluid Actions - Fill Routines - Aspirate Sol. D**".
   In glu/lac/urea – mode, also activate "**Fill Reference Electrode**".
   Observe the input tube to the sample distributor during the aspiration process. The solution must be aspirated into the sample distributor reservoir without air bubbles (complete fluid column).
   When a new bottle is inserted, air is aspirated in the beginning - if necessary, call up function twice.
4. Activate "**System - Cal - System Cal**".
   Initiate a system calibration by pressing the "**Start**" key.

Changing the contact clip

When changing the contact clip (see Fig. 29), please proceed as follows:

1. Open the analyzer cover, the MC cover and the contact clip.
2. Pull off the contact clip (in vertical, fully opened position) from the axis in forward direction.
3. Remove the new contact clip from the package.

NOTE: *Always hold the contact clip sideward by the handle only and make sure not to touch the contacts!*

4. Assemble the new contact clip (in vertical, fully opened position) onto the axis.

NOTE: *Before closing the contact clip for the first time, a MSS cassette or MSS dummy cartridge has to be installed.*

Changing the push pins

When changing the push pins (see Fig. 28), please proceed as follows:

Push pins at **RCon** (or **reference**- and **dummy electrode**) (see Fig. 28, **11**):

1. Open the analyzer cover, MC cover, contact clip and locking lever and remove the **RCon** (or the **reference**- and the **dummy electrode**) (see Fig. 29).
2. Pull the corresponding push pin out of the measuring chamber (e.g. with flat pliers).

Push pin/Cover contact (see Fig. 28, **4**):

1. Open the analyzer cover and the MC cover.
2. Pull the push pin out of the measuring chamber (e.g. with flat pliers).

Assembly is done in reverse order.

NOTE: *Push pins at **RCon** (or **reference**- and **dummy electrode**) and cover contact are not identical.*
Make sure to use the same type of push pins for replacement.

Changing the cooling block

When changing the cooling block (see Fig. 29), please proceed as follows:

1. Activate the program "**System - Util - Analyzer Actions - Park Cartridges - SD Cartridge**" to retract all valve tappers.
2. Remove the SD cartridge as described on page 5-122).
3. Open the MC cover, the contact clip and the locking lever and remove the **RCon** (or the **reference**- and the **dummy electrode**) and the MSS cassette.

NOTE: *The MSS cassette should not be removed from the system for more than 10 minutes to prevent damage to the enzyme sensors.*

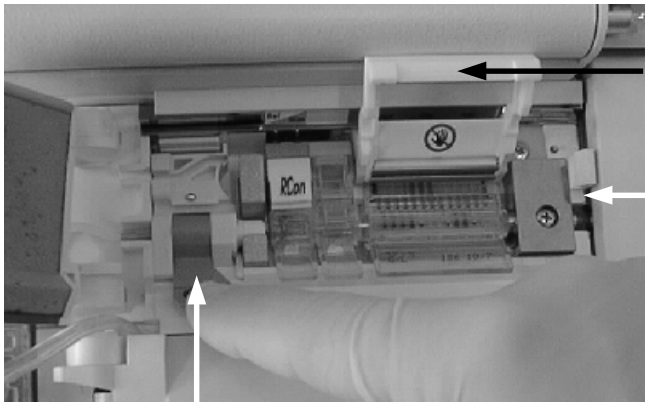


Fig. 29: MSS measuring chamber (2)

4. Unscrew the Phillips screw from the cooling block and remove the cooling block.

Assembly is done in reverse order.

NOTE: *Ensure a clean surface and proper positioning of the cooling block in the cooling ledge.*

Activate "**System - Util - Analyzer Actions - Fluid Actions - Fill Routines - Aspirate Sol. D**".
In glu/lac/urea – mode, also activate "**Fill Reference Electrode**".
Observe the input tube to the sample distributor during the aspiration process. The solution must be aspirated into the sample distributor reservoir without air bubbles (complete fluid column).
When a new bottle is inserted, air is aspirated in the beginning - if necessary, call up function twice.
Change back to the "**Ready**" - screen.

Changing the SSE (MSS) Amp Glu/Lac and the SSE (MSS) Mainboard

Electrostatic Sensitive Device

When changing the SSE (MSS) Amp Glu/Lac board and the SSE (MSS) Mainboard (see Fig. 28, **1**), please proceed as follows:

1. Remove the MSS measuring chamber as described on page 5-59).
2. Loosen the measuring chamber ledge (see Fig. 28, **14**).
3. Remove the shielding cover of the MSS module.
4. Disconnect all cables from the board and unscrew the respective fastening screws.
5. The SSE (MSS) Amp Glu/Lac board can be removed through the top. Carefully pull the SSE (MSS) Mainboard out toward the back (danger of damaging the heater control).

Assembly is done in reverse order.

Changing the Connector board (BG- and ISE module only)

Electrostatic Sensitive Device

When changing the Connector board, please proceed as follows:

1. To disassemble the Connector board, first remove the BG- or ISE measuring chamber. Follow the instructions on page 5-52 or page 5-55.
2. To open the measuring chamber, press the measuring chamber cover gently to the left.
3. Remove the measuring chamber ledge (see Fig. 24, **8** or Fig. 26, **5**).
4. Disconnect the connector for the MC illumination foil and the measuring chamber cover heater (see Fig. 24 and Fig. 26, **a** and **b**).
5. Push the leg approx. l cm to the outside following the direction of the arrow (see Fig. 24 and Fig. 26, **2**) and remove the Connector board.

Assembly is done in reverse order.

NOTE: *The polarization voltage is to be reset after changing the Connector board of the BG measuring chamber (see chapter 8, "Service Area - Setup - O2 UPol").*

Changing the measuring chamber cover heating (measuring chamber electronics)
(BG- and ISE module only)

Electrostatic Sensitive Device

When changing the measuring chamber cover heating, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Remove the analyzer cover and remove in the upward direction.
3. To open the measuring chamber, press the measuring chamber cover gently to the left.
4. Loosen both Phillips screws and remove the connection strip.
5. Loosen the tension relief of the flat cable, which leads to the measuring chamber cover, and remove from the plug with a pair of tweezers.
6. Lift the measuring chamber electronics from the measuring chamber cover with a flat screwdriver at the points marked with arrow in Fig. 30.

Assembly is done in reverse order.

NOTE: *When reassembling the measuring chamber electronics pay attention to the assembling position (see Fig. 30) of the MC foil. The MC foil is coded and must be inserted into the measuring chamber cover so that the slanted edge is positioned in the direction of the measuring chamber hinge.*

Changing the MC cover completely

When changing the MC cover completely, please proceed as follows:

1. Press the key "**System**" in the "**Ready**" - screen. This prevents the pumping of fluids during the changing of components.
2. Remove the analyzer cover and remove in an upward direction.
3. To open the measuring chamber, press the measuring chamber cover gently to the left.
4. Loosen both Phillips screws and remove the connection strip (BG -and ISE module only).
5. Loosen the tension relief of the flat cable, which leads to the measuring chamber cover, and remove from the plug with a pair of tweezers (BG -and ISE module only).
6. Slightly pull up the MC cover; press it down turning it slightly to the right. The MC cover disengages from the hinge.

Assembly is done in reverse order.

NOTE: *When reassembling the MC cover, make sure that the bottom hinge is seated in the groove and push it up if necessary.*

Changing the MC prism
(BG- and ISE module only)

The changing of the MC prism is done in the same manner as the changing of the measuring chamber cover heating (see page 5-64).
The flat cable does not have to be removed.
After disassembling the measuring chamber electronics, remove the MC prism.

Assembly is done in reverse order.

NOTE: *Please make sure that the MC foil does not fall out of the MC cover, when you are removing the MC prism.*
If necessary, position the MC foil in the MC cover as described on page 5-68.

Changing the MC electrode holder

When changing the MC electrode holder (see Fig. 24, **10** (BG), Fig. 26, **8** (ISE) or Fig. 28, **12** (MSS)), please proceed as follows:

1. Remove the analyzer cover and remove in an upward direction.
2. To open the measuring chamber, press the measuring chamber cover gently to the left.
3. Open the locking lever (and the contact clip at MSS module; see Fig. 29).
4. Remove the electrodes **REF** and **Jun** or **RCon** (or the **reference**- and the **dummy electrode**) and the MSS cassette (MSS module) from the measuring chamber.

NOTE: *The MSS cassette should not be removed from the system for more than 10 minutes to prevent damage to the enzyme sensors. MSS cassettes should therefore be stored in the MSS conditioning system, if available.*

5. Pull the MC electrode holder from the measuring chamber with the aid of the locking lever.
6. Remove the tube from the electrode holder.

Assembly is done in reverse order.
After reinstallation of the electrodes, barcode entry is not necessary.
Confirm the screen display by pressing "**Continue**".

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Recommendation (only when exchanging a MC electrode holder of a BG or ISE measuring chamber):

Activate "**System - Cal - Mixing System**".
The AVL OMNI™ performs calibration of the fluid mixing system.

Changing the center seal for MC

When changing the center seal for MC (see Fig. 24, **9** (BG), Fig. 26, **6** (ISE) or Fig. 28, **7** (MSS)), please proceed as follows:

1. Remove the analyzer cover and remove in an upward direction.
2. To open the measuring chamber, press the measuring chamber cover gently to the left.
3. Open the locking lever (and the contact clip at MSS module; see Fig. 29).
4. Remove the electrodes (**RCon** or the **reference**- and the **dummy electrode** as well as the MSS cassette at MSS module).

NOTE: *The MSS cassette should not be removed from the system for more than 10 minutes to prevent damage to the enzyme sensors. MSS cassettes should therefore be stored in the MSS conditioning system, if available.*

5. Use tweezers to remove the center seal for MC.

Assembly is done in reverse order.
After reinstallation of the electrodes, barcode entry is not necessary.
Confirm the screen display by pressing "**Continue**".

NOTE: *To avoid damaging the Center seal for MC, do not use tools to reassemble it.*

Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Recommendation (only when exchanging a center seal of a BG or ISE measuring chamber):
Activate "**System - Cal - Mixing System**".
The AVL OMNI™ performs calibration of the fluid mixing system.

Changing the MC foil
(BG- and ISE module only)

The changing of the MC foil is done in the same manner as the changing of the measuring chamber heating (see above).
After disassembling the measuring chamber electronics, remove the MC foil under the MC prism.

NOTE: *When reassembling the foil pay attention to the assembling position (see Fig. 30). The foil is coded and must be inserted into the measuring chamber cover so that the slanted edge is positioned in the direction of the measuring chamber hinge.*

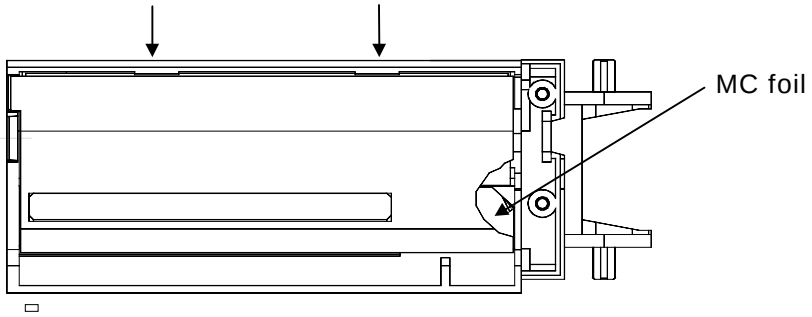


Fig. 30: Measuring chamber cover

Changing the MC illumination foil

When changing the MC illumination, please proceed as follows:

1. To disassemble the MC illumination foil, first remove the BG-, ISE- or MSS measuring chamber. Follow the instructions on page 5-52 (BG), page 5-55 (ISE) or page 5-59 (MSS).
2. To open the measuring chamber, press the measuring chamber cover gently to the left.
3. Open the locking lever (and the contact clip at MSS module; see Fig. 29).
4. Remove the electrodes (**RCon** or the **reference**- and the **dummy electrode** as well as the MSS cassette at MSS module).
5. Pull the MC electrode holder from measuring chamber with the aid of the locking lever.

For BG and ISE module applies:

- Remove the measuring chamber ledge (see Fig. 24, **8** or Fig. 26, **5**).
- Disassemble dummy electrode and seal.
- Disconnect MC illumination foil cable from Connector board.

For MSS module applies:

- Remove the shielding cover of the MSS module.
- Remove the measuring chamber ledge and the amplifier module (see Fig. 28, **14** and **15**).
- The left illumination foil (see Fig. 28, **10**) can now be removed.
- To change the right illumination foil (see Fig. 28, **8**) remove the screws **5** and **9** (see Fig. 28) and remove the clamping block.
- Pull the contact foil off the SSE (MSS) Amp Glu/Lac board and remove the contact foil with the carrier plate.

6. Remove defective MC illumination foil from the measuring chamber.
7. Clean the adhesive surface with cleaning alcohol.
8. Place the new MC illumination foil on a level surface and remove the backing paper.

NOTE: *Do not warp or bend the illumination foil!*

9. Paste the new MC illumination foil into the MC tray starting on the inside of the measuring chamber and flatten it with a sweeping motion to both sides.

NOTE: *The illumination foil must be pasted in one piece. It cannot be removed and pasted back in!*

10. Press the illumination foil down with a rounded tool.
11. Coat the edge of the illumination foil on the measuring chamber with sealing wax 400.

NOTE: *Without ventilator, the sealing wax must sit for 12 hours, with ventilator at least one hour.*

12. Remove excessive wax with a dry gauze pad.

NOTE: *Do not use solvents for cleaning!*

Assembly is done in reverse order.

Changing the MC hinge

When changing the MC hinge, please proceed as follows:

1. To disassemble the MC hinge, first remove the BG-, ISE- or MSS measuring chamber. Follow the instructions on page 5-52 (BG), page 5-55 (ISE) or page 5-59 (MSS).
2. To open the measuring chamber, press the measuring chamber cover gently to the left.
3. Slightly pull up the MC cover, press it down turning it slightly to the right. The MC cover disengages from the hinge.
4. Press the turn-lock fasteners in the direction of the arrow see Fig. 31) and turn them 90°.
5. Remove the hinges.

Assembly is done in reverse order.

NOTE: *When reassembling the hinges, pay attention to their assembling position (see Fig. 31).*
top hinge: along tubing guide
bottom hinge: along chamfer

The MSS module has reinforced hinge springs. Make sure to use the same type of springs for replacement.

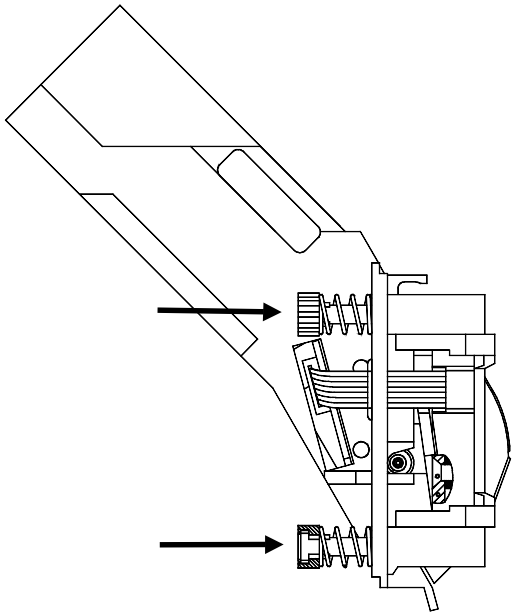


Fig. 31: MC hinge

Changing the measuring chamber cartridge

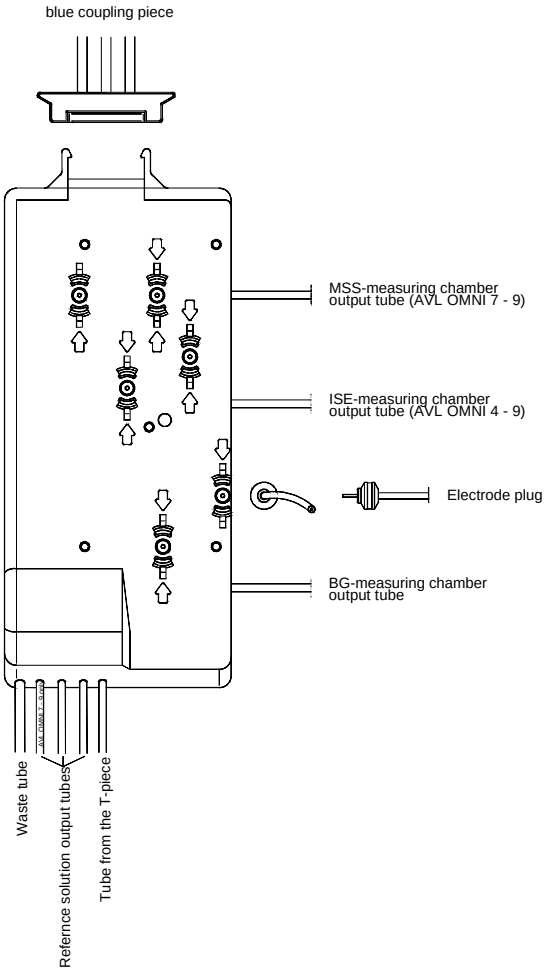

blue coupling piece
MSS-measuring chamber output tube (AVL OMNI 7 - 9)
ISE-measuring chamber output tube (AVL OMNI 4 - 9)
Electrode plug
BG-measuring chamber output tube
Waste tube
Refernce solution output tubes
Tube from the T-piece

Fig. 32: MC cartridge

When changing the MC cartridge, please proceed as follows:

1. Activate the program "**System - Util - Analyzer Actions - Park Cartridges - MC Cartridge**" to retract all valve tappers.
2. Open the analyzer cover and remove in the upward direction.
3. Open the bottle compartment cover.
4. Disconnect the four (AVL OMNI™ 4 to 9) or two electrode plugs (black and white, see Fig. 32).
5. Disconnect the blue coupling piece (see Fig. 32).
6. Remove Solution 1, 2, 3 and 4 from the bottle compartment.
7. Open the tubing cover (see Fig. 86, **18**).
8. Pull off the Waste tube from the Waste cap T2 and remove from the tube guide (see Fig. 86, **19**).
9. Pull of the Reference solution output tubes (see Fig. 86, under tubing cover **18**).
10. Pull of the tube from the T-piece (see Fig. 86, **20**).

11. Open the measuring chambers (see Fig. 86, **23** and **24**) and pull off the Measuring chamber output tube with a flat pair of tweezers.
12. Loosen the 5 screws on the measuring chamber cartridge and remove it.

NOTE: *Before replacing the electrode plugs clean their coupling piece on the measuring chamber with cotton swab.*

NOTE: *Do not use a sharp edged pair of tweezers to remove the tubing.*

Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

The measuring chamber tubing can be connected easily by disassembling the electrode holder.
After reassembling a MC cartridge, please confirm the display on the screen with "**Continue**" and change back to the "**Ready**" - screen.

Amplifiers

Amplifier/Measuring chamber	Blood gas	ISE
POT 9700LP1	•	•
AMP 9700LP2	•	
REF 9700LP3	•	•

POT 9700LP1

The POT 9700LP1 is an amplifier for the voltage supplying electrodes (Na, PCO_2, pH etc.). The dipolar PCO_2-electrode is connected directly on the inputs ELIN and REF. The unipolar electrodes receive their reference voltage from the Reference electrode over the reference amplifier, on the REF input of the contact ledge J1.

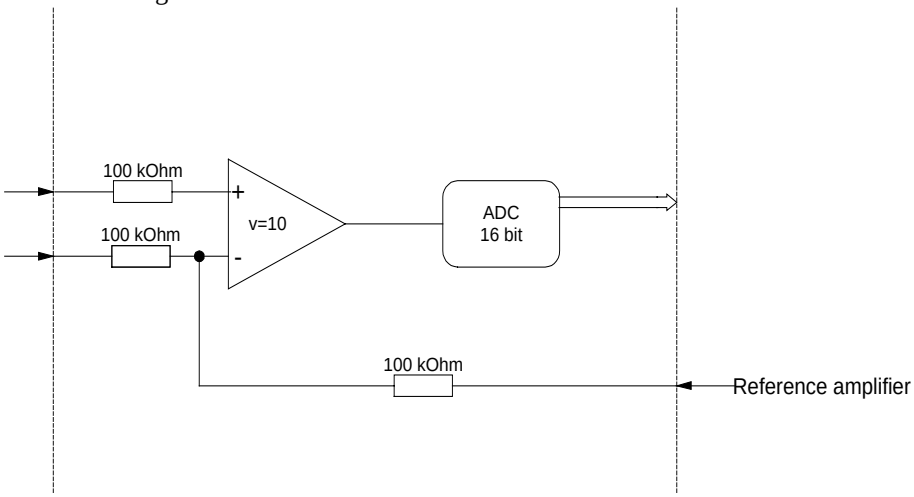


Fig. 33: POT 9700LP1

Circuit description:

The inputs are high resistance transformers, which control the differential amplifier (v=10). Thereafter, a filter (fg=10Hz) and an AD conversion takes place. The digital data is given serially.

AMP 9700LP2

The AMP 9700LP2 is an amplifier for power supplying electrodes (PO_2). The electronics consist of two functioning parts:

- Production of variable polarization voltage UPOL
- Strobing circuit

A galvanic separation is provided, in order to prevent that the voltage to be measured is spread via the measuring chamber. The power supply is given by a galvanically separated DC/DC-converter, the signal transmission by the optocoupler.

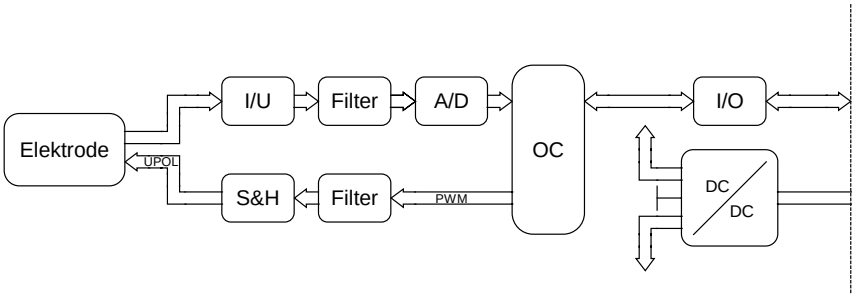


Fig. 34: AMP 9700LP2

Circuit description:

The measuring module control offers the I/O-driver the PWM (pulse width modulated polarization voltage). The optical linking path separates galvanically. A filter produces a DC from the PWM. The S&H (Sample&Hold) stage holds the polarization voltage (UPOL) ready, during the electrode measurement time. During this time, the next electrode amplifier can be set on another UPOL.
The electrode measurement flow is converted into an intensified measuring voltage over the I/U converter and supplies the AD converter by means of a frequency distortion noise impairment filter. The digital measurement signal is then offered to the external computer by the optocoupler (OC) and the I/O-driver.

REF 9700LP3

The REF 9700LP3 is used for the amplification of the Reference electrode signal. In addition, the measuring chamber central nipple contact (MCC) in the Junction and the measuring chamber output nipple contact (MCO) in the Reference electrode which control the measuring chamber filling, are grounded through.

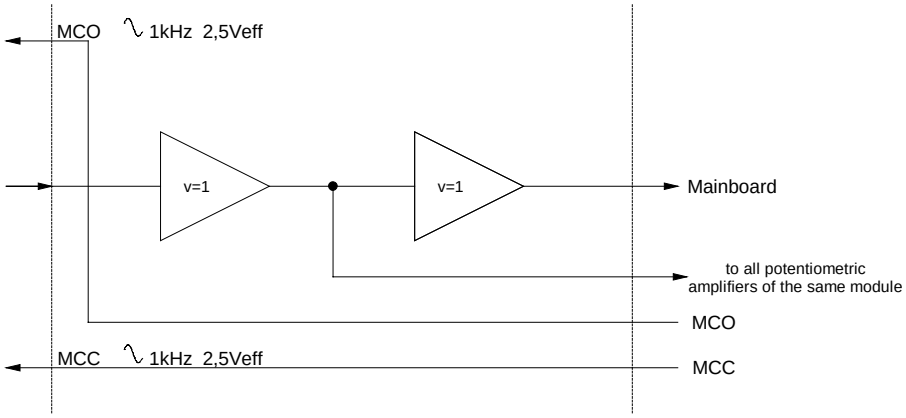


Fig. 35: REF 9700LP3

Circuit description:

The unipolar Reference electrode signal is transferred to the potentiometric electrodes of a measuring chamber by an impedance converter. Herewith, the measuring circle for unipolar electrodes is closed. A decoupled reference signal is offered for use on the computer.
For the dipolar potentiometric PCO_2-electrode the reference signal provides a potential clamp. In order to prevent the clamp from reaching too a high value for the PCO_2-electrode circuit when an error on the Reference electrode occurs, limit on the input side of the Reference electrode signal of approx. 2V results.

COOX module (AVL OMNI™ 3, 6 and 9)

The COOX module consists of the following components:

- Lamp unit
- Cuvette holder with cuvette
- Polychromator
- Optical light guide - primary and secondary
- PolyOx-KX-control 9700 LY3

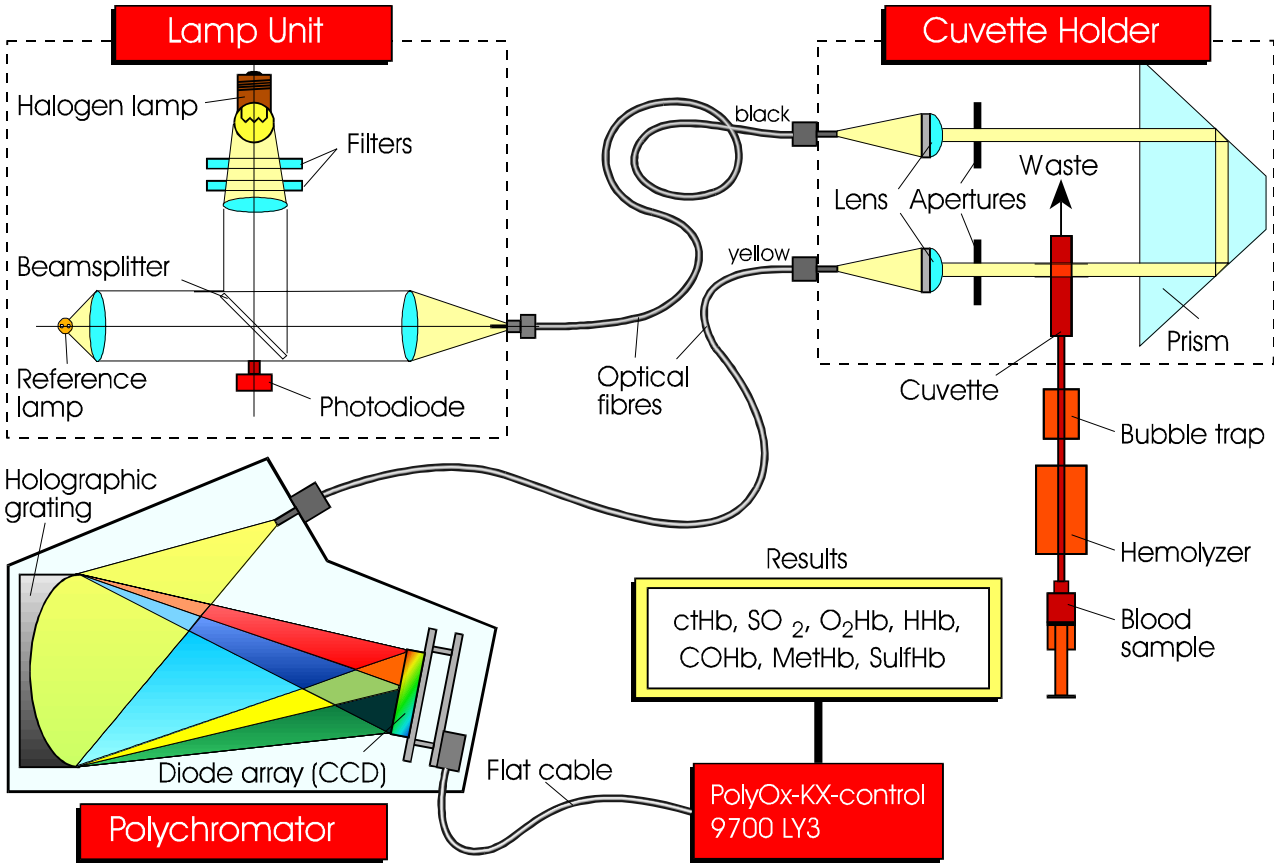


Fig. 36: COOX module - principal of operation

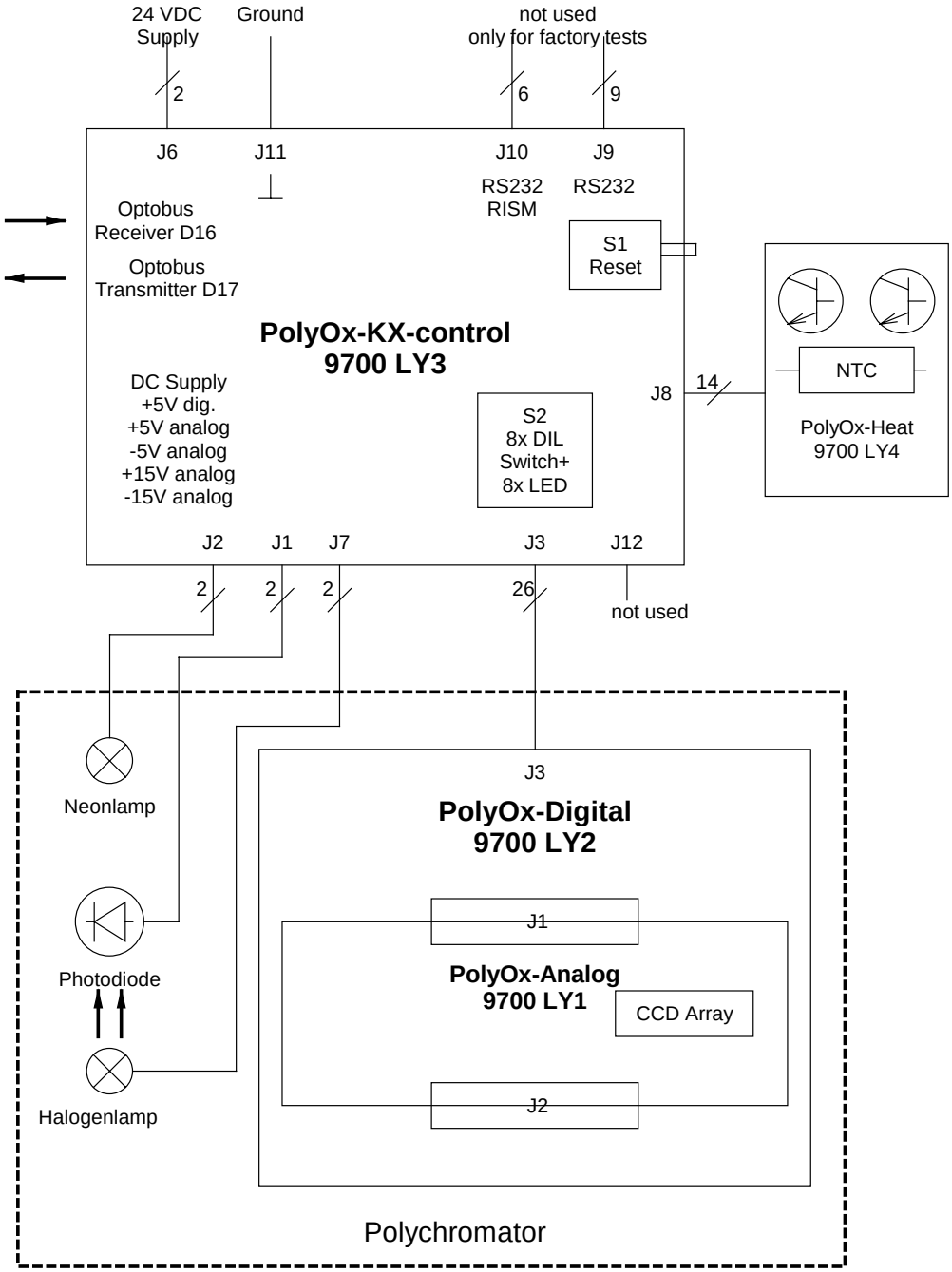


Fig. 37: COOX - Electronic

Function

The lamp unit contains a halogen lamp for sample measurement and a neon lamp for wavelength calibration. The primary optical light guide transmits the light to the cuvette holder, a prism deflects it through the cuvette and the secondary optical light guide transmits it to the polychromator. Inside the polychromator, the light is diffracted into its spectral components on a holographic grating and detected by a CCD (charge-coupled device) array. The already processed and digitized signal is transmitted to the PolyOx-KX-control 9700 LY3 via a ribbon cable for further processing.

Description of mechanical components

NOTE: *Lamp unit, cuvette holder and polychromator are adjusted at the factory and can only be exchanged as units.*

Lamp unit

The lamp unit contains two light sources:

- a halogen lamp for sample detection and measurement
- a neon lamp for wave length calibration

In addition, a photo diode controls the brightness of the halogen lamp. The primary optical light guide transmits the light from both lamps to the cuvette.

Changing the lamp unit

When changing the lamp unit please proceed in the following manner:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect neon lamp cable from connector **J2** (see Fig. 39) on the PolyOx-KX-control 9700 LY3 (see Fig. 39, **6**).
5. Unscrew the neon lamp supply line from connector **J7** (see Fig. 39) on the PolyOx-KX-control 9700 LY3.
6. Unplug the reference diode from connector **J1** (see Fig. 39) on the PolyOx-KX-control 9700 LY3.
7. Unlock the optical light guide (see Fig. 39, **12**) and pull it off the lamp holder.
8. Remove the screw on the lamp holder base (see Fig. 40, **6**) inside the device and loosen the screw on the PolyOx-KX-control 9700LY3 (see Fig. 40, **5**).
9. Pull the lamp holder (see Fig. 39, **8**) off towards the inside of the device.

Assembly is done in reverse order.

Cuvette holder

In the cuvette holder, the light transmitted by the primary optical light guide is first bundled by a lens and deflected by a prism before it enters the measuring cuvette. A second lens is used for transmission to the polychromator by the secondary optical light guide. To ensure a consistent temperature in the cuvette, the entire cuvette holder is thermostated to 37 °C by the integrated heater block.

Changing the cuvette holder (see Fig. 40, 2)

When changing the cuvette holder, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Pull off the tubes on the right and left sides of the cuvette holder (see Fig. 40, **1**).
4. Gain access to the rear of the analyzer.
5. Pull off the optical light guide (see Fig. 39, **2** and **3**).
6. Disconnect cable from connector **J8** (see Fig. 39) on the PolyOx-KX-control 9700 LY3 (see Fig. 39, **6**).
7. Remove the three screws on the back of the cuvette holder and remove the cuvette holder.

Assembly is done in reverse order.

Changing the cuvette

When changing the cuvette, please proceed as follows:

1. Press the key "**System**" in the "**Ready**" - screen. This prevents the pumping of fluids during the changing of components.
2. Open the bottle compartment cover.
3. Place your thumb on the cutout of the cuvette holder cover and push up the magnetic clip (see Fig. 39, **1** and Fig. 38, **a**). The cuvette holder disengages.
4. Push up the fastening clip with the aid of a pointed object (see Fig. 38, **b**).
5. Hold the fastening clip up and remove the cuvette with a pair of tweezers (see Fig. 38, **c**).

NOTE: *Use caution when handling the new cuvette - never touch the surface with bare hands. Hold the cuvette at the outer rim only (see Fig. 38, **d**).*

6. Carefully insert the cuvette and place it in position (see Fig. 38, **e**).
7. Push down the fastening clip until it engages.
8. Close the cover of the cuvette holder.

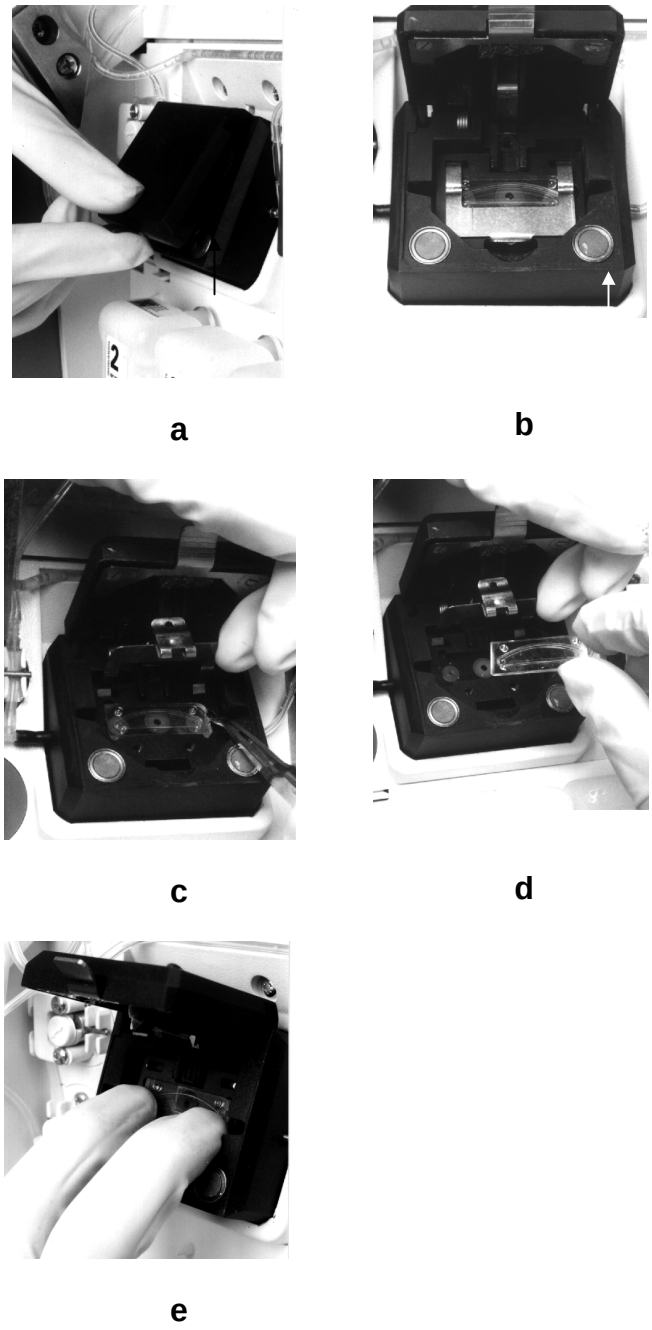


Fig. 38: Changing the cuvette

Activate program "**System - Cal - COOX Cal.**".
Initiate a COOX calibration (see Operator's Manual, Chapter 6, "Calibration", "COOX-Calibration") by pressing the "**Start**" key.

Polychromator

The polychromator diffracts the light transmitted by the secondary optical light guide into its spectral components on a holographic grating. The spectrum is imaged on a CCD (charge coupled device) and converted into electrical signals. The electronics unit integrated in the polychromator is responsible for amplification and analog-digital conversion of the signals and communication with the PolyOx-KX-control 9700 LY3 via the ribbon cable.

Changing the polychromator (see Fig. 39, 10)

When changing the polychromator, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove the screws from the lamp holder (see Fig. 40, **5** and **6**).
5. Pull the optical light guide (see Fig. 39, **13**) off the polychromator and remove it from the cable clip.
6. Disconnect the polychromator cable from connector **J3** (see Fig. 39, **9**) on the PolyOx-KX-control 9700 LY3 (see Fig. 39, **6**).
7. Disconnect the ground cable (see Fig. 39, **4**).
8. Remove the four screws securing the polychromator (see Fig. 40, **a, b, c, d**).
9. Remove the polychromator.
10. Disassemble the polychromator carrier from the just removed polychromator and assemble it on the new polychromator in the same position.

Assembly is done in reverse order.

NOTE: *Be sure to reconnect the ground cable after reassembly of the polychromator, otherwise the measurement values may be inaccurate.*

Optical light guides

The COOX module uses two optical light guides. The primary optical light guide (black) connects the lamp unit with the cuvette holder (top connector). The secondary optical light guide (yellow) transmits the light from the cuvette holder (bottom connector) to the polychromator.

Changing the optical light guides (see Fig. 39, 2 and 3)

When changing the optical light guides, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer and replace the optical light guides observing the following instructions:

NOTE: *When winding up the optical light guides, make sure that the black light guide has 6 or 7 windings, and the yellow light guide has only 1!*
The bending radius of the black light guide has to be ≥ 40 mm!

Do not bend the optical light guide during this procedure!

Connect the optical light guide immediately after removing the light guide protection!

Never touch or contaminate front surface of the optical light guide!

*Check for the color coding and the optical light guide end marked "**K**" (chamfered connector):*

***Black** - from lamp holder to cuvette holder top*
***Yellow** - from polychromator to cuvette holder bottom, with the light guide tip marked "**K**" connected to the cuvette holder.*

Plug the optical light guide in until it engages and then lock the bayonet connector!

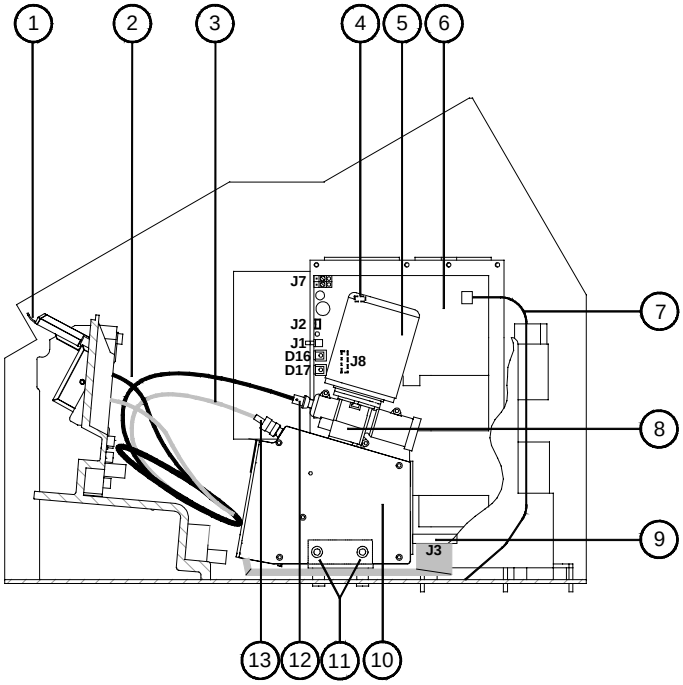


Fig. 39: COOX module (side view)

1	.....	Magnetic clip
2	.....	Optical light guide black
3	.....	Optical light guide yellow
4	.....	Grounding
5	.....	Lamp unit
6	.....	PolyOx-KX-control 9700 LY3
7	.....	COOX supply
8	.....	Lamp holder
9	.....	J3 with polychromator cable
10	.....	Polychromator
11	.....	PCR carrier
12	.....	Primary light guide with Lamp holder
13	.....	Secondary light guide with Polychromator

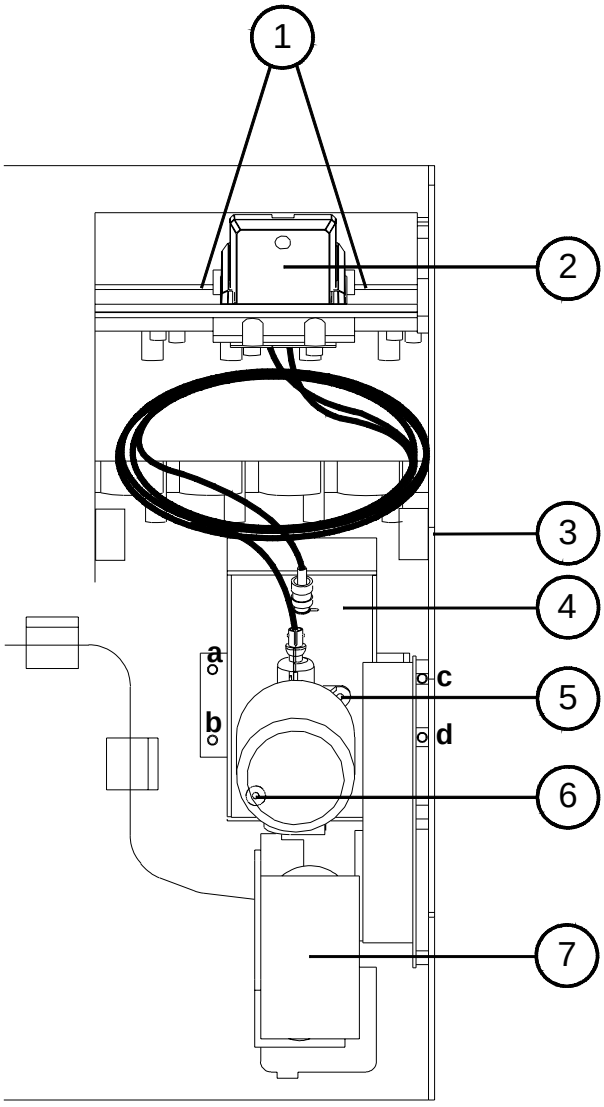


Fig. 40: COOX module (top view)

Description of electronic components

The electronics unit of the COOX module consists of 4 boards and the corresponding circuits.

- PolyOx-KX-control 9700 LY3
- PolyOx-Digital 9700 LY2
- PolyOx-Analog 9700 LY1
- PolyOx-Heat 9700 LY4

PolyOx-KX-control 9700 LY3

This card is used as the main control for the entire optics module and at the same time as commutations module to the main AVL OMNI™ device.
The 80C 196 KC microprocessor (10 MHz) controls the following functions and circuits:

- Memory and microprocessor interface (32 K ROM, 2 x 128 K RAM), buffered by "gold" capacitors
- Serial interfaces (RS232) for production tests (not used in the device)
- Interface for optobus (optical data transfer to main device AVL OMNI™)
- Voltages generated from +24 V DC (input): +5 V digital, +/-5 V analog and +/-15 V analog
- Lamp control for halogen lamp
- Temperature control for measuring chamber
- Voltage generation and switching for neon lamp
- Protective circuit for switching on power units
- Interface to CCD component

Function Description:

Voltage supply

The supply voltages for the modules +5 V digital (for digital logic circuit), +/-5 V (for analog measuring circuits) and +/- 15 V (for CCD array) are directly generated from the 24 V DC. Power consumption of the entire module is approx. 300 mA in standby mode and 2 A max. with activated halogen lamp.

Lamp control

With the aid of a DAC, the microprocessor applies a nominal voltage to the halogen lamp (11.5 V) and with the aid of a PI-controller and a photodiode as an actual-value transmitter, constant brightness is controlled. If the measuring diode is defective or not connected, lamp voltage is limited to 12.2 V_{max}. An additional controller signal informs the computer whether the controller is engaged and functional. The lamp voltage is switched on via a ramp with an aid of a pulse width regulator. In addition, filament breakage of the lamp is detected with an aid of a voltage measurement. Another protective circuit ensures that the lamp voltage is only active when the +5 V digital voltage is applied.

Neon lamp supply

With the aid of a cascade circuit, a nominal voltage of 65 V DC / 5 mA is generated from the 24 V, the trigger voltage is 135 V, the no-load voltage of the cascade is 190 V_{max}. In case of a short circuit in the neon lamp, the supply voltage collapses due to the high internal resistance of the cascade circuit, preventing a thermal overload of the components.

Protective circuit for periphery

A periphery enable signal controlled by the computer prevents switching on of the heater control and the halogen lamp voltage, if the microprocessor does not start up properly.

Temperature control for measuring chamber

The cuvette measuring chamber is heated and the sample material thermostated with the aid of 2 heat transistors and a high precision NTC resistor arranged on the subprint PolyOx Heat 9700 LY4 and directly screwed onto the measuring chamber. The nominal temperature value is preset in the range between 36 °C and 38 °C by the microprocessor via a DAC. Protective circuits are activated in case of an NTC interruption to limit the heat output to 3.5 W keeping the temperature in the measuring chamber to 40 °C max. They also ensure software detection by the controller to turn off the heater in case of an error. The heater current is also turned off, if one of the supply voltages fails.

Voltage checks

With the aid of the internal ADC, the microprocessor checks the following voltages:

- + 15 V analog
- + 24 V voltage supply
- + 2,5 V reference voltage
- Heater current transistor 1
- Heater current transistor 2
- Neon lamp voltage control
- Nominal value halogen lamp
- Ground
- and via a precise 16 bit ADC:
- Ulock (lamp brightness control locked)
- Actual measuring chamber temperature
- Desired measuring chamber temperature
- Neon lamp voltages
- + 5 V digital
- - 5 V analog
- - 15 V analog

Changing the PolyOx-KX-control 9700 LY3 (see Fig. 39, 6)

Electrostatic Sensitive Device

When changing the PolyOx-KX-control 9700 LY3 please proceed in the following manner:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove vacuum pump (see Fig. 40, **7**), by unscrewing the three screws at the vacuum pump base and laying the pump down inside the device.
5. Pull the optical light guide off the cuvette holder (see Fig. 40, **2**).
6. Pull all cables off the PolyOx-KX-control 9700 LY3.
7. Remove the four screws securing the polychromator (see Fig. 40, **a, b ,c, d**) and swivel it to the left.
8. Remove the nine fastening screws of the PolyOx-KX-control 9700 LY3 and remove it

Assembly is done in reverse order.

Description of LED's on PolyOx-KX-control 9700 LY3

LED No:	Designation	Description
1	+5 V	should be illuminated: 5 V digital supply
2	Reset	should not be illuminated
3	TR	Optobus send
4	RCV	Optobus receive
5	HT	lights up when heater is not connected or defective
6	NC	not connected
7	NC	not connected
8	Res_SLV	should not be illuminated (reset line for polychromator)

Desired position of Rocker switches on PolyOx-KX-control 9700 LY3

Rocker switch 1	OFF
2	ON
3	OFF
4	OFF
5	OFF
6	OFF
7	OFF
8	OFF

PolyOx-Analog 9700 LY1

This card is directly plugged into the PolyOx-Digital 9700 LY2 via connectors Jl and J2. Both cards are assembled in the actual optics module and are adjustable to ensure an optimal optical adjustment of the CCD array. The card contains the CCD array (512 elements) and the fast 16 bit ADC (20 ms scanning time).

PolyOx-Digital (Slave Controller) 9700 LY2

This controller card is used for fast scanning and saving of ADC data, recorded in the CCD array on the PolyOx-Analog 9700 LY1. Data transfer to the PolyOx-KX-control 9700 LY3 occurs after completion of a measurement cycle. A 80C196KC microprocessor with 128 kB RAM and 32 kB RAM is used. Communication with the main processor on the PolyOx-KX-control 9700 LY3 is established via an 8 bit parallel interface with handshake.

tHb measuring chamber and tHb cartridge (AVL OMNI™ 2, 5 and 8)

Function

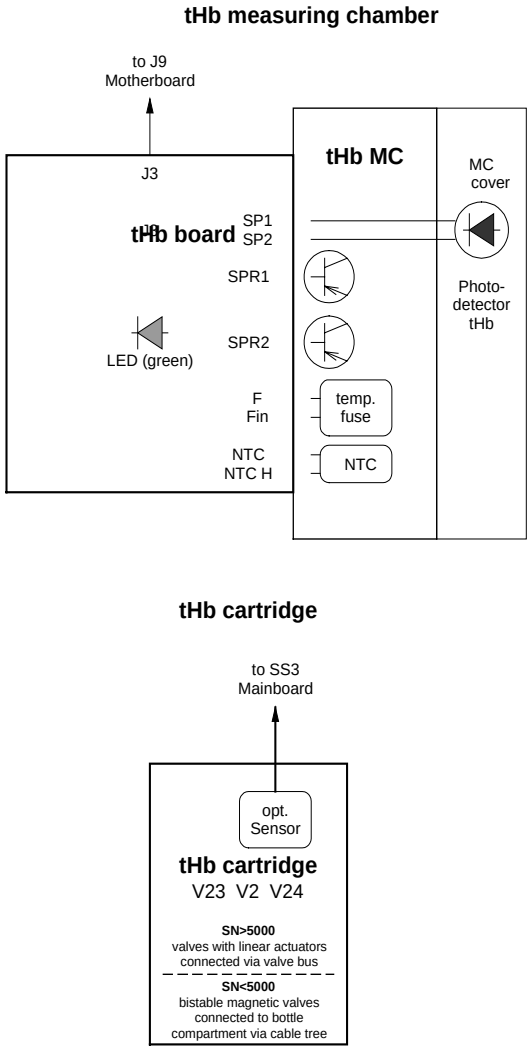


Fig. 41: Wiring - tHb module and tHb cartridge

The measurement of tHb is performed with help of an optical measuring cell using hemolyzed whole blood. For this reason, a hemolyzing unit in which the erythrocytes are destroyed with help of ultrasound is switched before this optical measuring cell, or tHb measuring chamber. The tHb cartridge is necessary for the correct filling of the hemolyzer and the measuring chamber. This consists of an optical sensor built-up with optical light guides and 3 valves. The single parts of the tHb module are built-in in the bottle compartment.

The tHb measuring chamber (see Fig. 86, **16**) contains the tHb measuring cuvette, located on a thermostated block (37 °C ± 0.5 °C), a green LED as light source and the receiving photodiode, located in the cover of the

measuring chamber. The control circuit, located on the tHb board, contains the temperature regulation circuit, a constant power source, which supplies the light source (green LED, switchable), as well as the amplifier for the photodiode with a switchable amplification factor and low-pass filter.
The thermostating takes place with help of the heating transistors (which act as a cooling element in the measuring chamber block) and the thermal sensor (NTC). A temperature fuse is provided.
The control and supply of the module takes place over a 20-poled flat cable from J9 of the Motherboard.

The tHb cartridge contains the sample sensor SS3, optical light guide sensor, the other necessary optical elements (transmitter-LED and receiver-photodiode) are located on the Mainboard. The tHb cartridge contains 3 valves (V2, V23 and V24).

The tHb cartridge is substituted by the BC cartridge in analyzers without the tHb module and only contains V23 and no V2, no V24 and no sample sensor SS3.

Changing the tHb measuring chamber

Electrostatic Sensitive Device

When changing the tHb measuring chamber (see Fig. 86, **16**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Remove Solution 1, 2, 3 and 4 from the bottle compartment.
4. Pull off the tubes on the right and left sides of the tHb measuring chamber.
5. Open the tubing cover (see Fig. 86, **18**), by pressing the two releasing levers down.
6. Gain access to the rear of the analyzer and disconnect J9 from the Motherboard.
7. Disconnect the grounding of the tHb measuring chamber.
8. In order to remove the tHb measuring chamber from the analyzer, loosen the 2 screws on the measuring chamber and the Phillips screw under the tubing cover.

Assembly is done in reverse order.

When reassembling the tHb measuring chamber connect the tubes from right to left as follows:

1. Press the measuring chamber releasing button (see Fig. 86, **17**). The measuring chamber cover springs open.
2. Press the red securing button, the cover of the cuvette springs open.
3. Connect the tubes carefully with help of a pair of tweezers.

NOTE: *Do not use a sharp edged pair of tweezers to remove the tubing to avoid damage of the tubing.*

4. Close both covers of the tHb measuring chamber by pressing.
5. Press the securing button (see Fig. 86, **16**), to close the tHb measuring chamber again.

Changing the tHb cartridge

When changing the tHb cartridge, please proceed as follows:

1. Activate the program "**System - Util - Analyzer Actions - Park Cartridges - tHb Cartridge**" to retract all valve tappers.
2. Open the analyzer cover and remove in the upward direction.
3. Pull off the two tubes on the tHb cartridge, as well as the tube from the Waste container.
4. Open the 2 screws on the tHb cartridge and remove them.

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Assembly is done in reverse order.

After reassembling a MC cartridge, please confirm the display on the screen with "**Continue**" and change back to the "**Ready**" - screen.

Changing the optical sensor SS3

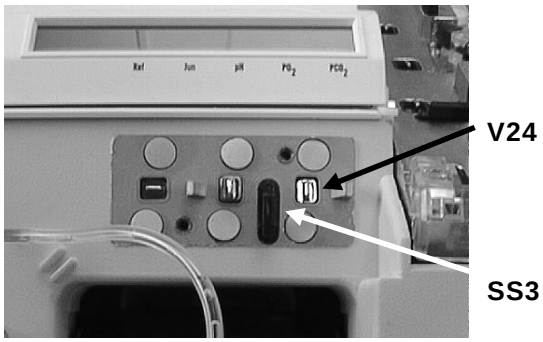


Fig. 42: Optical sensor (sample sensor) SS3

1. Disassemble the tHb cartridge as described on page 5-90.
2. Switch off the AVL OMNI™.
3. Disconnect all cables (power cable, barcode, etc.) from the AVL OMNI™.
4. Tip the screen in the forward direction.
5. Open the bottle compartment cover.
6. Pull off the tubes **1** and **2** (see Fig. 43) from the sample distributor.

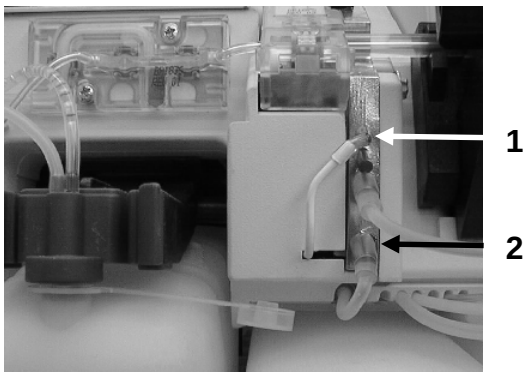


Fig. 43: Sample distributor

7. Open the Phillips screws on the back of the analyzer.
8. Remove the rear panel diagonally in the upward direction.
9. Remove the grounding plug from the rear panel.
10. Unscrew the two Phillips screws, which hold the measuring chamber, plate, and pull up until it clicks into place.
11. Gain access to the rear of the analyzer.
12. Remove V24 as described on page 5-151.
13. Disconnect the optical sensor from the Mainboard.
14. Remove the sample sensor.

Assembly is done in reverse order.

Changing the interference filter

(To be done every 3 to 4 years).

When changing the interference filter, please proceed as follows:

1. Disassemble the tHb measuring chamber as described in “Changing the tHb measuring chamber” page 5-90.
2. Remove the NTC- and TWF-plugs from the tHb board.
3. Loosen both Phillips screws, which hold the transistors.

NOTE: *When reassembling the transistors, please be sure to assemble in the same manner as originally (isolationplatelets etc.).*

4. Press the measuring chamber releasing button (see Fig. 86, **17**). The measuring chamber cover springs open.
5. Press the red securing button, the cover of the cuvette springs open.
6. Open the two connecting screws between the cuvette holder and the measuring chamber ledge (accessible from the front).
7. Now remove the tHb board from the measuring chamber.
8. Remove the O-ring and the interference filter.
9. Insert the new interference filter with the mirrored side towards the LED, with a slight turning motion.

NOTE: *Do not press the interference filter into the clearance in any case. If necessary, carefully insert once again. In order to avoid damage on the varnish coat on the sides take care in positioning the interference filter correctly and do not touch with tools. Polish away fingerprints or the like, with a clean cloth or paper handkerchief.*

Assembly is done in reverse order.

Changing the cuvette

When changing the cuvette, please proceed as follows:

1. Press the key "**System**" in the "**Ready**" – screen. This prevents the pumping of fluids during the changing of components.
2. Open the bottle compartment cover.
3. Press the measuring chamber releasing button (see Fig. 86, **17**). The measuring chamber cover springs open.
4. Press the red securing button, the cover of the cuvette springs open.
5. Remove cuvette.

NOTE: *Use caution when handling the new cuvette – never touch the surface with bare hands. Hold the cuvette at the outer rim only (see Fig. 38,* ***d****).*

6. Insert the new cuvette and close the cover.
7. Close the cover of the tHb-measuring chamber by pressing the upper button until it engages.

Activate the program "**System – Cal – tHb Cal.**".
Pressing the key "**Start**" a tHb calibration (for details, please refer to Operator's Manual, chapter 6, "Calibration", section "tHb calibration") will be started.

Motherboard

Function

A detailed description of Motherboard functions can be found in Chapter 3, “Description of functions / Specifications”.

Changing the Motherboard

Electrostatic Sensitive Device

When changing the Motherboard, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under “General information on assembly and disassembly of components”.
3. Gain access to the rear of the analyzer.
4. Carefully remove the fan unit out a few centimeters, disconnect the supply cable of the fan unit from the Motherboard and remove the fan unit.
5. Disconnect all cables from the Motherboard.
6. Press down both ejection flaps (see Fig. 87, **3**), the Mainboard is separated from the plugs of the Motherboard.
7. Loosen the 4 securing screws of the Motherboard.

Assembly is done in reverse order.

Checking the supply voltage and the reference voltage

Testpoints for the different supply voltages as well as the reference voltage (over the Mainboard plug connector) are provided:

-12 V	GND2	+12 V		protective ground
x	x	x		x
x	x	x	x	x
+5 V	+24 V	GNDP (24 V)	-2.5 V Ref	+2.5 V Ref

The allowed tolerances are given for the respective supply voltages +/-5%. In the case of reference voltages + or –2,500 V, +/-10 mV is valid, when measured against the analog grounding (GND2). This is only for control purposes.
A setting of the reference voltage P1 on the Mainboard may only be done when measurement is performed by the described check points opposite GND ST5. Setting accuracy at +/-1 mV. It is to be noted that the setting must be made with an at least 5-digit tested DVM, since this setting influences all absolute temperatures of the temperature regulation.

Components location

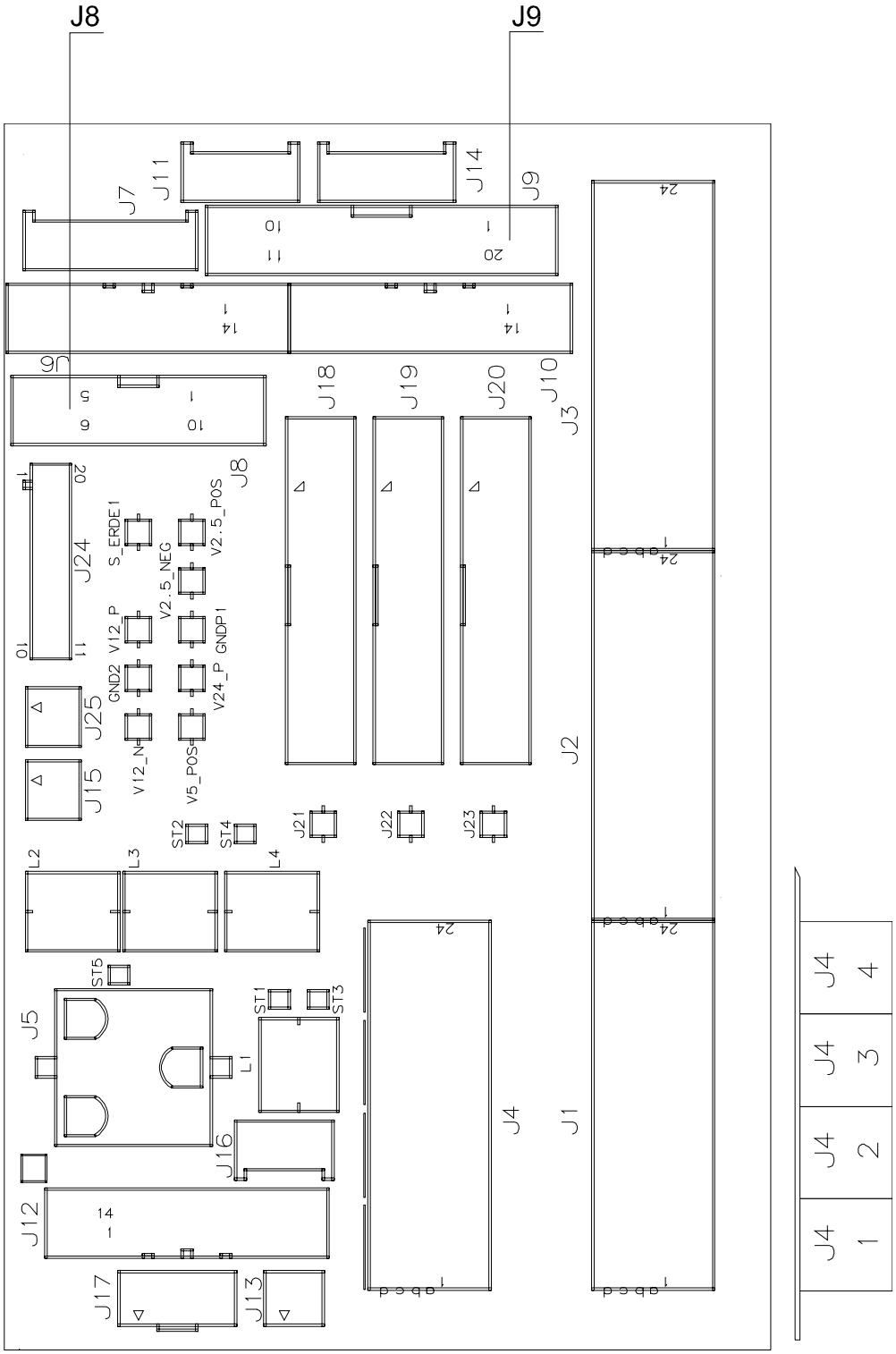


Fig. 44: Components location

Power supply unit

The power supply unit supplies all modules and components with the required voltages respectively.

The power supply unit consists of the

- power jack with the fuse holder, including two fuses and switches, and the
- all mains set power supply.

Technical data

Primary switched mode power supply, 110 W (continuos output), 200 W power peak
Input range:100 ÷ 240 VAC, 50 Hz – 60 Hz,
Outputs: +5 V / 5 A
+12 V / 2 A
-12 V / 0.3 A
+24 V / 2.5 A
The outputs are safe against short circuits and overloads.
The fan for the power unit, which is built-in the PC towers, is not a part of the power unit components.

NOTE: *The fuses located in the fuse holder are only to be exchanged with fuses of the same type (EV0158 2.5 AT).*

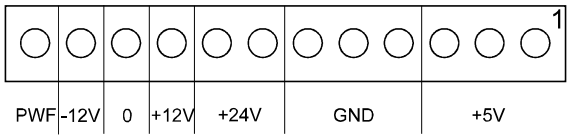


Fig. 45: Pinning of power supply connector

Changing the power supply unit

When changing the power supply unit, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Open the Phillips screws on the back of the analyzer.
3. Remove the rear panel diagonally in the upward direction.
4. Remove the grounding plug from the rear panel.
5. Unplug all cables and grounding from the power supply unit.
6. Loosen the two Phillips screws above the main switch (see Fig. 84, **10**) and one on the bottom of the device (see Fig. 84, **6**) and remove the power supply unit towards the rear of the analyzer.

Assembly is done in reverse order.

PC components

(applicable from SN 1500 on; for SN < 1500, see chapter 10, Manual revision 3.0)

Directory structure

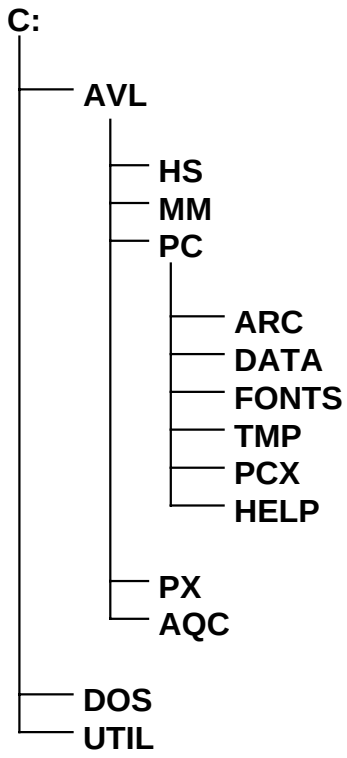


Fig. 46: Directory structure

C:\ ..... root directory (autoexec.bat, config.sys, ...)
C:\DOS ..... MS DOS Version 6.22
C:\UTIL ..... various utilities for internal use
C:\AVL\HS ..... pages to download for main control
C:\AVL\MM ..... pages to download for the measurement module
C:\AVL\PX..... pages to download for COOX module
C:\AVL\AQC..... pages to download for AutoQC module
C:\AVL\PC ..... main directory of the PC part of AVL OMNI™
C:\AVL\PC\TMP ..... directory for temporary use (storage of pictures)
C:\AVL\PC\ARC ..... compressed avopto‘s + Backup files
C:\AVL\PC\FONTS .... font files
C:\AVL\PC\DATA ..... database files (Cal-DB, Sample DB, QC DB, Maintenance DB)
C:\AVL\PC\HELP..... all text files for help pages
C:\AVL\PC\PCX..... all PCX pictures

Setup files in C:\AVL\PC

file	content
AVL_KX.INI	serial number
	sound switch / volume (0-5)
	cal. simulation
	storage of AVOPTO
	storage mode measurement
	hospital name
	neg. Hb derivatives
	COOX correlation
	help line number
	service keyboard
	main switch - economy mode
	main switch - AutoQC
	autom. Pat. ID
	main switch - hematocrit
	main switch - lock QC parameters
	main switch - MSS temp. increased
	main switch – AQC temperature correlation
	main switch - turbidity correction
	main switch - urea correction
	main switch – net mode
	main switch - thermal printer
	main swotch – Solution 6
	AVOPTO switch
	switch for service report
	switch for paper backfeed
	switch for paper take-up unit
	selected language
	AVL OMNI™ type
	software version
	PC software version
	video mode
	button / window / edit styles
	fonts
	net transmission of LF-Values (LF-Values, measurements, maintenance)
SETUP1.AVL	default values for input parameters
	default values for measured parameters
SETUP2.AVL	selected input parameters
	selected calculated parameters
SETUSER.AVL	all user definable correlations
	internal correlations f. Hb derivatives
SETUPR.AVL	reference / critical ranges
	switches for reference / critical ranges
SETUPRD.AVL	reference / critical ranges (default)

CISETUP.KX	definition of custom lines
DBSTATUS.KX	data base status
DEEDATA.KX	sample type
	blood type
	sample counter
	intervals of calibrations
	start time of sys cal.
	format of the date
	calibration values of COOX
	selected measurement report
	baro settings
	times of next calibrations
	interface settings
	FMS time
	main switch for password system
	module priority
	run counter (QC)
	calibration report switches
	fill levels
	not calibrated parameters
	deactivated parameters
	reagent components
	mixing ratio
	number of protocols to print
	unit setup
	data for MC temp. controlling
	setup for economy mode
	Hct offset
	acoustic alarm signal
	AQC back flush error counter
	QC lockout status
	open time - password system
	Limit of counter for cleaning procedure, actual counter for cleaning procedure, setup for cleaning
	Setup for data archiving
FILLDATA.KX	expiration date / insertion date of reagents
FONTDEF.KX	definition of fonts for the internal printer
QCDATA.KX	act. setup of QC materials
	QC multirule switches
RMSETUP.KX	maintenance setup
LANGDEF.KX	list of additional languages
MEASPROT.xxx	definition files for measurement reports
ASTMCONF.AVL	definition of values, which are selected for ASTM measurement report

FNTAB.AVL	definition file for internal printer
PARFONT.AVL	selected fonts for internal printer
PRNLST.AVL	list of installed external printer drivers
SPO.DAT**	history files for service report
ASCII.FMT	definitions for measurement reports - ASCII-Host
TPI.FMT	definition file for ticket printer
USERS.USR	definition file for password system
AQCSETUP.KX	AQC setup
AQCSTATE.KX	AQC status

other files in C:\AVL\PC

DOWNLOAD.CFG ..... configuration file for downloading the micro controller software
GET_KINI.EXE ..... executable file to rescue parts of AVL_KX.INI
SETVERS.EXE ..... executable file to restore parts of AVL_KX.INI
WORK.ARJ/WORK3.ARJ ..... archives of installed software
MEASPR0[n].DFL ..... default configuration of measurement protocol for AVL OMNI [n] (factory setting)
RMSETUP.DFL ..... default configuration of maintenance reminder (factory setting)
SETDEF.AVL ..... default settings for user correlations
SETKONST.AVL ..... factory correlations ***(don‘t modify!)***
SETUPFIX.AVL ..... definition file for all parameters
ASCII.DRV/EPSLX850.DRV/ EPSON.DRV/ STYLUS.DRV/ HPIJ500C.DRV ..... drivers for external printers, according to PRNLST.AVL
SP_PROT.AVL ..... configuration file for service report ***(don‘t modify!)***
TEXTE.ENG/GER ..... text files, containing the most general buttons and window text strings
TKBD.ENG/GER ..... configuration files for the "on screen keyboard layout"
MTMORE.ENG/GER ..... text files for "more detail " texts used in “Module Test”
TRSHDET.ENG/GER ..... text files for troubleshooting functions
ERROR.GER/ENG ..... text files for the error handler
EXPOPT.KX ..... settings for the export functions in data manager
DATA_ID.H96 ..... for development use only
STATE.H ..... for development use only
AVLERROR.TXT ..... for development use only
SERCOM.TXT ..... for development use only
STARTLOG.TXT ..... for development use only
INFO.TXT ..... for development use only

PC tower (AT96 with PC B486SLC)

(Applicable from SN ≈2560 on; for SN < 2560, see chapter 10, Manual revision 3.0 and 6.0)

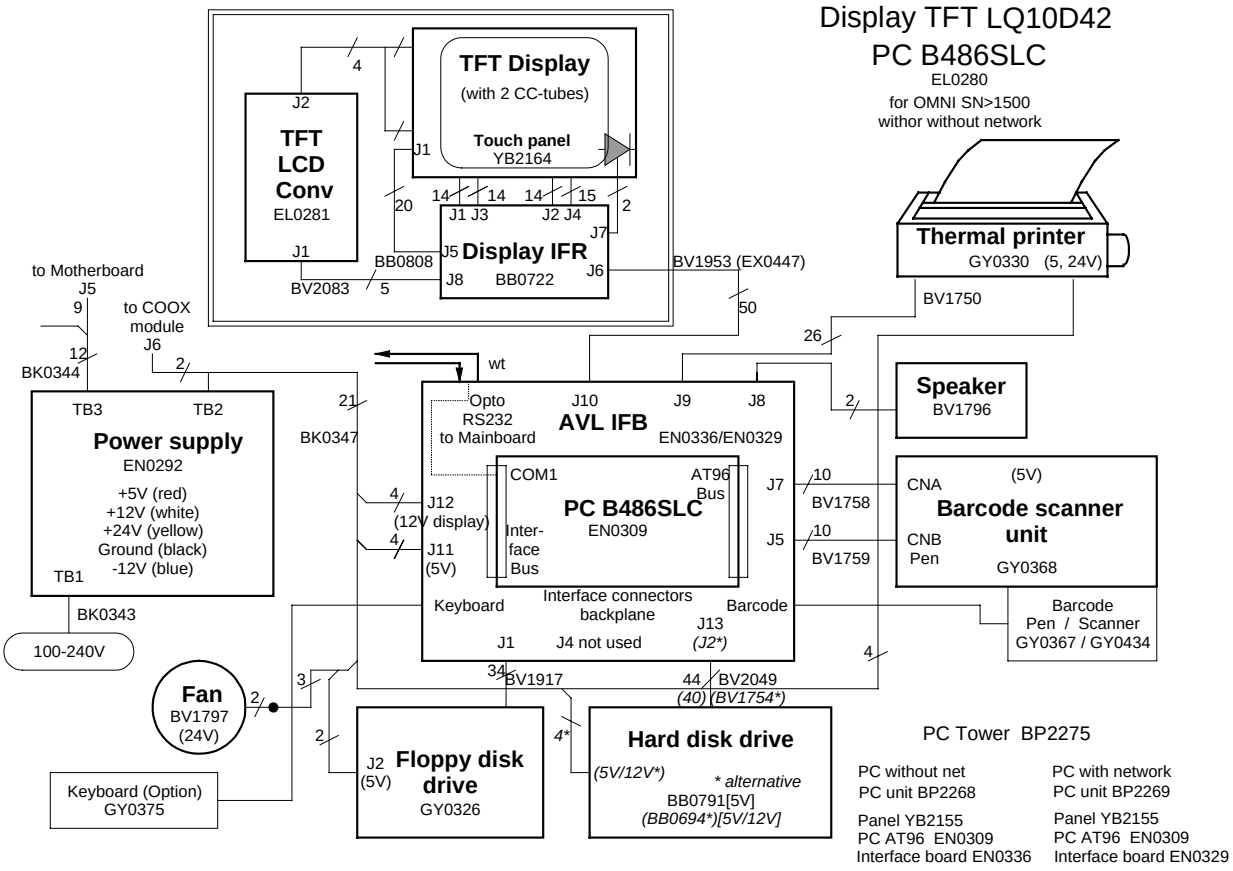


Fig. 47: PC tower (version AT96)

The PC tower of the version AT96 in the AVL OMNI™ includes the following components:

PC board based on the 486SLC
Interface board (AVLIFB, 2 variants, with and without network connector)
Floppy drive
Alternative 2.5“ or 3.5“ hard disk
Barcode scanner unit
Thermal printer
Speaker
Power supply unit for the entire AVL OMNI™
Fan (for the PC unit)

The display TFT LQ10D42 (with 2 cold cathodic fluorescent tubes) has the advantage of a high brightness and a very large reading angle range of more than +/- 35 ° vertically.
A 50-pole cable connects the display to the AVLIFB (see Fig. 48, **J10**).

On the display, the 50-pole cable connects to Display IFR board (**J6**). This card is necessary for the screen keys and the conversion of the screen signals. From the Display IFR board, a 20-pole cable connects to the actual flat screen and a TFT-LCD converter (necessary for background lighting). The Display IFR board contains its own microcontroller which converts the signals from the matrix of the touch panel into serial signals. lt is assembled in the screen housing.

The TFT LCD converter is a transformer and provides the voltage supply for the fluorescent lamps located behind the flat screen in the screen housing.

The hard disk is assembled on the inside of the PC tower, the floppy drive is located on the rear panel (as seen from the rear panel of the analyzer) (see Fig. 85, **1** and **3**).

PC board "B486SLC or 5x86"[1]

The basic part of the PC is a PC board of type B486SLC.
The single printed circuit board PC B486SLC contains complete PC electronics, including storage and driver for the floppy drive, hard disk, printer and flat screen. It is connected on the AVLIFB with 2 plug ledges (AT96 bus and interface bus). This is fastened to the rear panel of the PC tower (see Fig. 85, **5**) and includes the necessary interface-expansion with the corresponding plug connectors which are located on the rear panel of the analyzer.
The Barcode control (see Fig. 85, **7**) serves as an interface between the barcode scanner (connected on the rear panel with its own plug connector) and the PC and is assembled on the left side panel of the PC tower (as seen from the rear panel).
The printer module has a parallel Centronix interface and is connected to the respective PC interface. It is assembled on the PC tower.

The PC board B486SLC consists of:

- two serial interfaces (TTL gauge) COM1 (interface for main control) and COM2 (interface for touch screen),
- a parallel interface LPT1 (internal printer),
- a VGA compatible local bus video interface for:
  – analog monitors
  – active color LCD
  – passive color LCD
- 512 kB video RAM
- a keyboard interface for standard PC/AT keyboards
- a floppy drive interface for two 3.5" floppy drives
- a hard disk interface for one IDE hard disk
- a real time clock with externally buffered CMOS-RAM (128 Byte)
- 4 MB working storage
- a CPU 486SLC with 33 MHz systemclock
- a PC/AT Motherboard logic (two DMA controllers, two interrupt controllers, one timer and one DRAM controller)
- a BIOS
- a watchdog and reset generator

The periphery signals for delivery on the AVLIFB, are conducted on a 128-poled, the BUS-signals of the AT 96-BUS on a 96-poled VG ledge.

[1] For serial numbers shown below (and higher), a board compatible with B486SLC with a 5x86 processor is used (has a small fan directly at the PC chip). The internal clock speed of 100 MHz (25 MHz external) permits faster processing of e.g. database functions.

AVL OMNI 1	5851, ≥ 5910
AVL OMNI 2	> 5893
AVL OMNI 3	5858, 5860, 5897, 5914, 5915, 5916, ≥ 5917
AVL OMNI 4	> 5718
AVL OMNI 5	≥ 5936

AVL OMNI 6	5919, ≥ 5920
AVL OMNI 7	≥ 5922
AVL OMNI 8	5866, 5867, ≥ 5924
AVL OMNI 9	5927, ≥ 5928,

Changing the PC board B486SLC / 5x86 (A007)

Electrostatic Sensitive Device

When changing the PC board (see Fig. 85, **4**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove the 2 Phillips screws (see Fig. 84, **10**) securing the power supply unit.
5. Remove the 3 Phillips screws (see Fig. 84, **a**, **b**, **c**) securing the PC unit (AVLIFB, PC board B486SLC and panel), slightly lift the PC unit and carefully swivel it to the side.
6. Pull off the PC board from the Interface board.

Assembly is done in reverse order.

NOTE: *1f PC board B486SLC and AVLIFB have the following revision levels, the boards have to be replaced together in case of malfunction.*

PC board B486SLC: 1.2
AVLIFB: 5.1

At higher revision levels the components can be replaced separately.

Changing the Interface board "AVLIFB"

Electrostatic Sensitive Device

The changing of the Interface board (see Fig. 85, **5**) is done in the same manner as the changing of the PC board, see above.

1. Disconnect all cables from the PC unit.
2. Remove the 4 Phillips screws securing the interface board AVLIFB to the panel (see Fig. 84, **d**, **e**, **f**, **g**).
3. Remove the 16 spacer bolts and EMC seals from the connectors.

Assembly is done in reverse order.

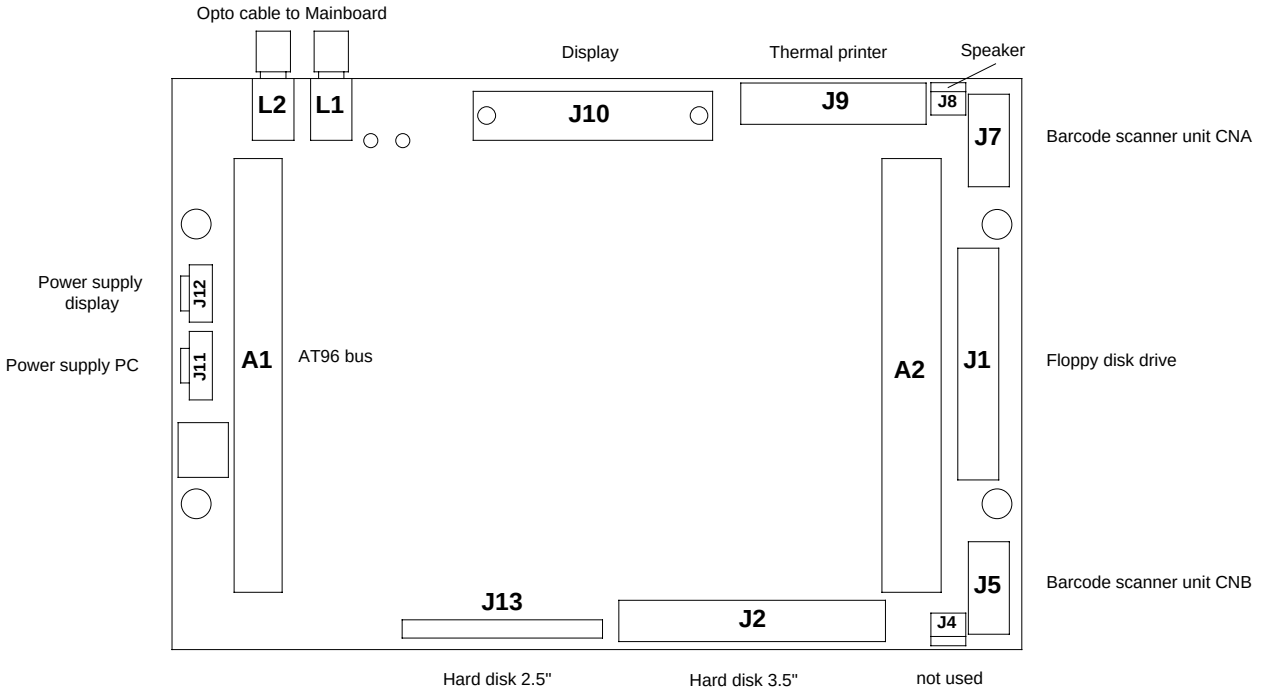


Fig. 48: AVLIFB

Changing the hard disk

Electrostatic Sensitive Device

NOTE: *Before you start with exchange, try to save all important values (e.g. calibration values under "**Data Manager - Cal. - More - Backup/Restore**").*

The 2.5" hard disk may be replaced with a 3.5" hard disk and vice versa[2]. Make sure to use the right cable with the right disk:
2.5" disk (BB0791) with cable BV2049
3.5" disk (BB0694) with cable BV1754 and BV1917 (5V/12V).

Remark: *Because of two different assemble situations, you will find two metal plates enclosed to the spare part BB0791.*

[2] This is applicable for AVLIFB's with ident number EN0329 or EN336 only.

When changing the hard disk (see Fig. 85, **3**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the 26-poled flat cable (data line) from the thermal printer.
5. Unscrew and the 4 Phillips screws, which hold the thermal printer and remove.
6. Disconnect the power supply and the data lines from the hard disk.
7. Unscrew the 4 Phillips screws, on the side panels of the PC tower.

Assembly is done in reverse order.

NOTE: *When reassembling the hard disk, please take care that the red line of the flat cable is positioned next to the power supply. Further, pay attention that the supply line from the thermal printer is not exchanged with that of the hard disk (plug labeling).*

After replacement of the hard disk, restore data manager data (if possible), customer settings and instrument-specific values (O2-UPol, Baro S value, actual barometric pressure, COOX offset values, sample counter, hotline number, serial number, AutoQC serial- and revision number as well as number of total measurements) and perform a software update (see Chapter 8, section “Software update and Service area”).

*Data previously saved by the operator can be restored in the menu "**Data Manager - Maintenance - More - Restore**".*

Interface board "AVLIFB"

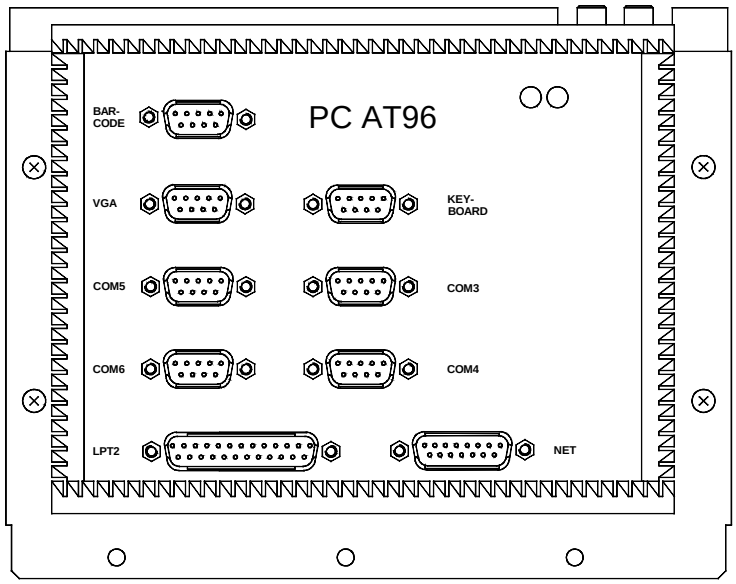


Fig. 49: Interfaces

The AVL OMNI™ is equipped with four serial interfaces (COM 3, COM 4, COM 5 and COM 6) for data transfer one printer interface (LPT2) and further interfaces (keyboard, barcode, etc.).

NOTE: *To prevent damage to the AVL OMNI™, it is necessary to compare the pin assignment of the AVL OMNI™ with that of the customer device (e.g. barcode scanner, barcode reader, external keyboard, terminal, etc.), before connecting these to the AVL OMNI™.*
AVL will not be liable for any damage resulting from nonobservance of this prerequisite.

For details about interfaces, please refer to AVL OMNI™ Operator's Manual, chapter "Interfaces".

Photoconductor interface on COM1

The transmit- and receive signals of the serial interface COM1 of the PC board are designed as optical interface.
Only transmit- and receive-signals from the TTL level on light or from light on the TTL level are converted.
These TTL signals are shown over LED's for control purposes.

Touch panel interface on COM2

The signals of the touch panels are carried on the receive input of the serial interface COM2.

Serial interfaces COM3, COM4, COM5, COM6

Two IBM compatible multifunctional building elements, each with two serial interfaces and one printer interface, are integrated on the AVLIFB. On the one hand, the signals of the AT96-bus are transferred to these building elements, on the other, the signals of the serial interfaces are conducted over the RS232/V24 level converter on 9-poled SUB MIN D-bush. The signals of the printer interface are carried out. This printer board can be reached as a LPT2 (see bellow).

Pin assignment

Pin 1	DCD	Data carrier detected
Pin 2	RxD	Receive data
Pin 3	TxD	Transmit data
Pin 4	DTR	Data terminal ready
Pin 5	GND	Signal ground
Pin 6	DSR	Data set ready
Pin 7	RTS	Request to send
Pin 8	CTS	Clear to send
Pin 9	RI	Ring indicator

Keyboard and barcode scanner interface

The barcode scanner used allows the mixed operation of the scanner unit together with a standard PC/AT-keyboard. To assure this operation, the signals from the keyboard are carried out by an external connection "**Keyboard**" on the connector J7.
The signals of the scanner unit are carried out over the external connection "**Barcode**" on the connector J5 (see Fig. 48).

Pin assignment – keyboard

Pin 1	CLK	clock
Pin 2	Data	
Pin 4	GND	Signal ground
Pin 5	Vcc	+ 5V

Pin assignment – barcode scanner

Pin 1	Vcc	+ 5V
Pin 2	Data	
Pin 3	GND	Signal ground

Printer interface LPT1 and LPT2

The AVL OMNI™ integrated printer is connected to the computer over the connector J9 on the logical interface LPT1. The signals of the second thermal printer board are ranked as LPT2 on the external connection "**LPT2**" (see Fig. 48 and Fig. 49).

Flatdisplay interface

The signals of the active color LCD´s are carried by the 128-poled VG-ledge A2 on a 50-poled SCSI-2-cable (J10) (see Fig. 48).

Analog VGA interface

The transfer of the color signals to an external screen takes place over this interface (15-poled SUBMIN D).

NET connector (optional)

The PC AT96 is available with a 15-poled SUBMIN D (AUI) network connection.
Use of an RJ45 network connector requires an adapter for conversion from AUI to 10 BASE T.
The transmission protocol used is TCP/IP, ASTM E 1394 (software version > 5.0 required).

PC-Tower (PC104 with PC MSM486V)

(Applicable up to serial Number 2565; see chapter 10, Manual revision 8.0)
***Remark*:**
Replacement of the entire PC tower and the floppy drive in a PC 104 is performed corresponding to AT96.

Changing the entire PC tower

Electrostatic Sensitive Device

NOTE: *Before you start with exchange, save all important values (e.g. calibration values under "**Data Manager - Cal. - More - Backup/Restore**").*

When changing the entire PC tower (see Fig. 84) please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove the 4 fixing screws from the screen grid (only from SN 2000 on) and the 4 Phillips screws, which hold the thermal printer. Remove both.
5. Disconnect the power supply and the 26-poled flat cable (data line) from the thermal printer.
6. Unplug all cables of the PC tower.
7. Remove the cable clip above the floppy drive and disconnect the display cable from the MSMAVL.
8. Remove the 3 fixing screws for the PC tower (2 on the side panel, one on the bottom of the device) and remove the PC tower.

   Caution! - When removing the PC tower.
   If the AVL OMNI™ is used without AutoQC module, the barex tube of the pre-assembled AQC cable tree is fixed to the PC tower.

Assembly is done in reverse order.

NOTE: *After replacement of the PC tower, restore data manager data, customer settings and instrument-specific values (O2-UPol, Baro S value, actual barometric pressure, COOX offset values, sample counter, hotline number, serial number, AutoQC serial- and revision number as well as number of total measurements) and perform a software update (see Chapter 8, section "Software update and Service area").*

*Data previously saved by the operator can be restored in the menu "**Data Manager - Maintenance - More - Restore**".*

Changing the loudspeaker and the fan

When changing the loudspeaker and the fan (see Fig. 85, **6**, **8**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the 26-poled flat cable (data line) from the thermal printer.
5. Unscrew the 4 Phillips screws, which hold the thermal printer and remove.
6. **Loudspeaker**: Unscrew the Phillips screw and remove the loudspeaker.
7. **Fan**: Disconnect the supply line and remove the four holding screws.

Assembly is done in reverse order.

Changing the floppy drive

When changing the floppy drive (see Fig. 85, **1**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the data line from the floppy drive and remove the holding screw (see Fig. 85, **2**).
5. Push the floppy drive towards the side panel of the analyzer from the PC tower.

Assembly is done in reverse order.

NOTE: *To guarantee a troublefree operation of the floppy drive make sure that the side panel does not collide with the floppy drive. Adjust the side panel if necessary.*

Display

The display of the AVL OMNI™ is a TFT LCD - display, type Sharp LQ10D42.
(Applicable from SN ≈2800 on; for SN < 2800, see chapter 10, Manual revision 3.0 and 6.0)

Technical data

Panel size	10.4“
Pixel format	640 x 480
Dot pitch	0.11 x 0.33 mm
Backlight type	2 cold cathodic fluorescent tubes (CCFT, dual)
Colors	512
Viewing angle optimum	12 o’clock

Changing the entire touch screen

When changing the touch screen, please proceed as follows:

1. Pull the screen forward and remove the 4 Phillips screws to remove the screen housing.
2. Remove the Phillips screw from the cable clip and disconnect the 50-pole cable from the screen (see Fig. 50, **4**).
3. Pull off both tubes (see Fig. 86, **2**) on the sample distributor and remove from the securing clips.
4. The touch screen can now be disassembled by removing the five Phillips screws (see Fig. 86, **e** to **i**).

Assembly is done in reverse order.

NOTE: *Do not exchange the two tubes on the sample distributor when reconnecting.*

Changing the fluorescent lamp

When changing the fluorescent lamps, please proceed as follows:

1. Pull the screen forward and remove the 4 Phillips screws to remove the screen housing.
2. Remove the Phillips screw from the angle bracket and remove the angle bracket (see Fig. 50, **5**).
3. Remove the 3-pole connectors from the fluorescent lamps.
4. Pull the lamps from the housing on the right side.

Assembly is done in reverse order.

NOTE: *Always replace the fluorescent lamps simultaneously.*
The marking Δ on one of the two fluorescent lamps shows the installation position (see Fig. 50).

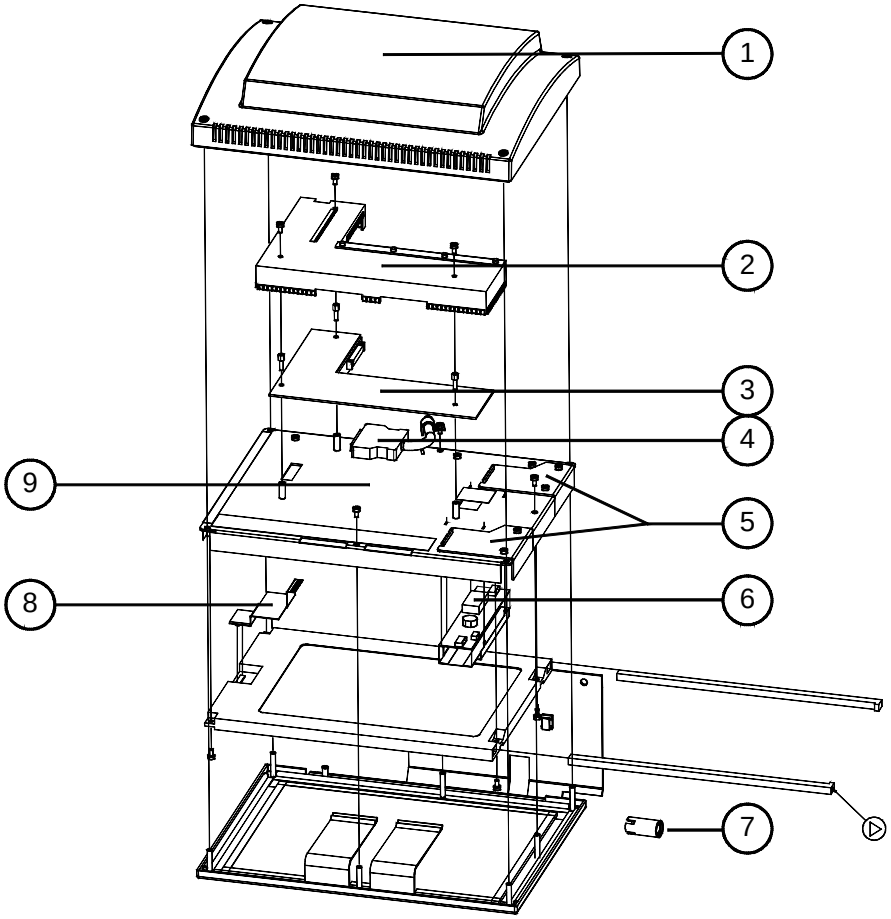


Fig. 50: Display

(1)	.....	Screen housing
(2)	.....	Shielding cover 2
(3)	.....	Display IFR
(4)	.....	50-pole cable with cable clip
(5)	.....	Angle bracket
(6)	.....	TFT LCD Converter
(7)	.....	Collar for display locking mechanism VD0172
(8)	.....	IFR Connector Board
(9)	.....	Shielding cover 1

Changing spare parts See installation drawing Fig. 50.

Peristaltic pump (PP)

Function

Transports the sample and the operational fluids in the analyzer.

Changing the peristaltic pump

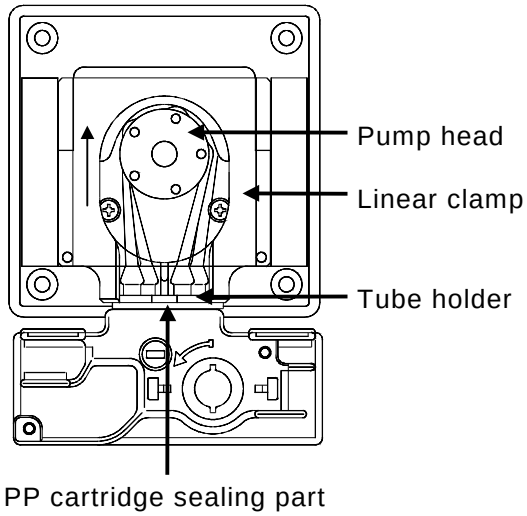


Fig. 51: Peristaltic pump

When changing the peristaltic pump, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.) under "General information on assembly and disassembly of components".
3. Open the plexiglass cover (tension lever) of the peristaltic pump and push the linear clamp (white plastic part) in the direction of the arrow (see Fig. 51).
4. Gain access to the rear of the analyzer.
5. Disconnect the grounding line.
6. Disconnect the stepper motor connections from the Motherboard and remove from securing clip.
7. Unscrew the 4 Phillips screws, which hold the peristaltic pump and remove them.

Assembly is done in reverse order.

Test the function of the pump tubing set in the menu "**System - Util - Analyzer Actions - PP Tubing Exchange**".

Changing the PP head

When changing the peristaltic pump head, please proceed as follows:

1. In the "**Ready**" screen press the key "**System - Util - Analyzer Actions - PP Tubing Exchange**" and follow the instructions on the screen.
2. Tip the screen in forward direction.
3. Open the PP cover.
4. Open the plexiglass cover (tension lever) of the peristaltic pump and push the linear clamp (white plastic part) in the direction of the arrow (see Fig. 51).
5. Remove the complete tubing set (tube holder and tubing).
6. Remove the setscrew (1.5 mm) from the pump head.
7. Pull off the PP head (see Fig. 51).
8. Attach the new pump head and secure it with the setscrew. Make sure that the setscrew grips on the flat side of the shaft.

NOTE: *Make sure that the pump head does not rub against the pump plate. If needed, position the pump head slightly higher.*

9. Place the tubing set around the roller (do not cross the tubes!).
10. Close the plexiglass cover (tension lever). The tubing holder is then pressed into the PP cartridge sealing part.
11. Close the PP cover and tip the screen in the upward direction.
12. Press the key "**Continue**".

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Changing the PP tubing set

When changing the PP tubing set, please proceed as follows:

1. In the "**Ready**" screen press the key "**System - Util - Analyzer Actions - PP Tubing Exchange**" and follow the instructions on the screen.
2. Tip the screen in forward direction.
3. Open the PP cover.
4. Open the plexiglass cover (tension lever) of the peristaltic pump and push the linear clamp (white plastic part) in the direction of the arrow (see Fig. 51).
5. Remove the complete tubing set (tube holder and tubing).
6. Place the tubing set around the PP head (do not cross the tubes!).

NOTE: *Use the white tubing holder (BP2228) exclusively!*

7. Close the plexiglass cover (tension lever). The tubing holder is then pressed into the PP cartridge sealing part.
8. Close the PP cover and tip the screen in the upward direction.
9. Press the key "**Continue**".

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

PP cartridge

Function

The main function of the PP cartridge is to couple the 4 tubing connectors of the peristaltic pump to the system, depending on desired aspiration function. Since the pump rotates to the left and right, this system incorporates several options.

The left tubing connectors are already connected to the pump connector and are thus controlled as a unit. They are connected to the converting line and can also be switched to the Waste (see tubing diagram, Chapter 7, "Functional procedures") via V14.

The right tubing connectors are connected separately.
The bottom tube on this side is directly connected to the Waste, the top tube on the right side is either connected to V15/16 or to the FMS (Fluid mixing system) via V17. VI5/16 can be used to establish connections with the Waste or the sample distributor.

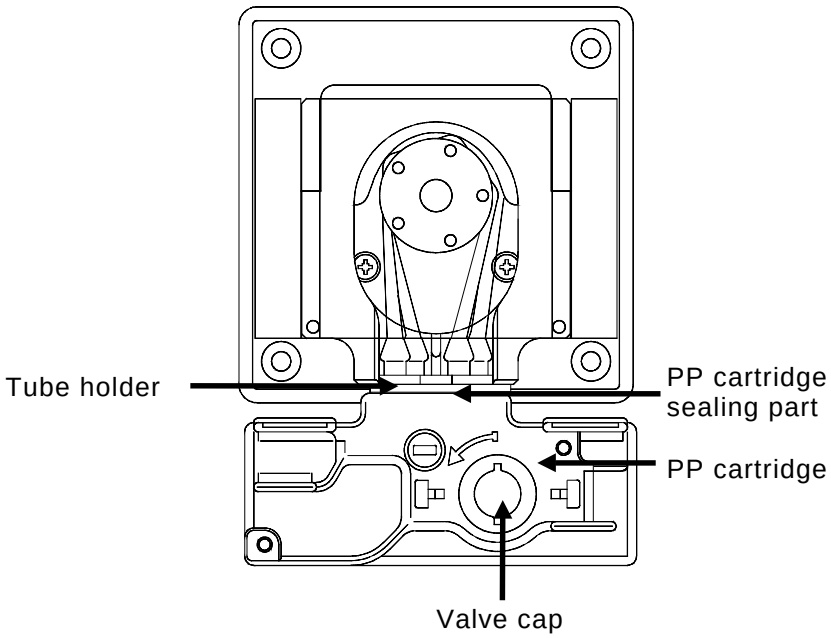


Fig. 52: PP cartridge

Changing the PP cartridge

When changing the PP cartridge (see Fig. 52), please proceed as follows:

1. Activate the program "**System - Util - Analyzer Actions - Park Cartridges - PP Cartridge**" to retract all valve tappers.
2. Open the analyzer cover and remove in the upward direction.
3. Remove the sample distributor cover.
4. Open the PP cover.
5. Open the plexiglass cover (tension lever) of the peristaltic pump and push the linear clamp (white plastic part) in the direction of the arrow (see Fig. 51) to relieve the pump tubes.
6. Pull off both tubes (see Fig. 86, **2**) from the sample distributor.
7. Unscrew both Phillips screws on the PP cartridge.
8. Disconnect the blue coupling piece (see Fig. 32).
9. Press the valve cap (see Fig. 52) down and turn in the direction of the arrow, (the grooves in the valve cap run horizontally) to release lock. Now, the PP cartridge can be removed.

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

After reassembling a PP cartridge, the valve cap must relock the PP cartridge, in other words, the grooves of the valve cap must be vertical.

Confirm the information with "**Continue**" and change back into the "**Ready**" - screen.

NOTE: *Do not exchange the two tubes on the sample distributor when reconnecting.*

Pre-filter

Function

This filter is used as a pre-filter for the filter inside the AVL OMNI™. The filter frame is attached to the outside of the rear panel with snaplocks; the upper part can be removed for filter replacement.

Changing the pre-filter

When changing the pre-filter, please proceed as follows:

1. Open the filter frame by pressing on the ribbed areas on the top, at the same time pulling the two clips up, disengaging the snaplock (**1**).
2. Tilt the upper part of the filter frame to the back (**2**).
3. Grasp the filter frame by the clip and pull it out (**2**).
4. Discard the pre-filter in accordance with local regulations (Biohazard!).

Assembly is done in reverse order.

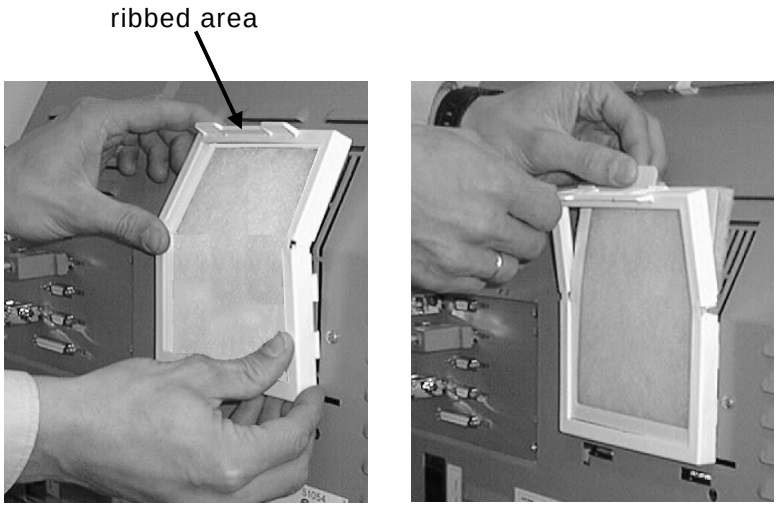
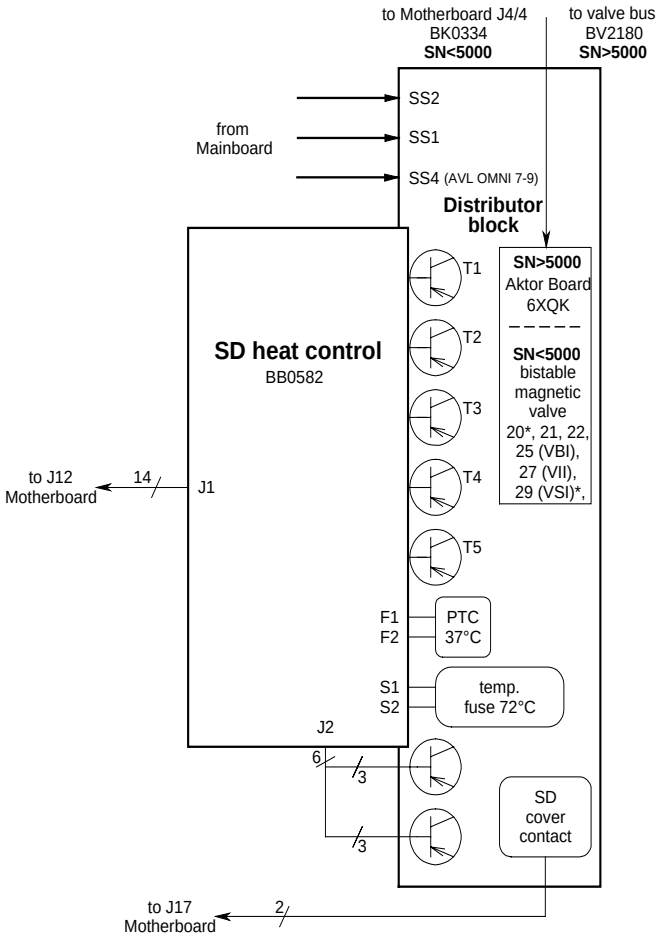


Fig. 53: Changing the pre-filter

Sample distributor (SD)

Function

The sample distributor is responsible for the distribution and thermostating of the calibration fluids or samples, in the separate measuring chambers. For this, a thermostated aluminum block is set upon a plastic (PVC) block. This contains the necessary tubing, the plastic tubes and T-pieces (shut-off by valves). Further, the valves, which pinch off the T-pieces, are located in the SD assembling.
Metal pipes are located in the aluminum block which simultaneously carry and thermostat the calibration fluids.
The samples themselves are thermostated with the help of a small metal block, located in the lower part of the sample distributor, which has thermal contact to the aluminum block of the sample distributor.
The thermostatization itself, is performed by the 7 heating transistors located on the SD heat control and the two respective control circuit, five of which (T1-T5), are directly soldered to the board and two are connected on J2. A PTC serves as a temperature sensor, which is adhered to the block and soldered to the connections F1 and F2. A temperature fuse is connected to S1 and S2.
A microswitch (SD cover contact) is located in the white plastic cover for the SD heat control, which signals the removal of the Sample distributor cover. The connections of this microswitch run directly to Motherboard J17.
The two optical sensors SS1, SS2 and SS4 (AVL OMNI™ 7-9) for the control of the aspiration procedures run directly to the Mainboard.
The control and supply of the sample distributor takes place over a 14-poled flat cable from the Motherboard J12.
The connections for the valves come directly from the Aktor Board 6XQK BB0856.



* AVL OMNI™ 7-9 only

Fig. 54: Wiring - sample distributor

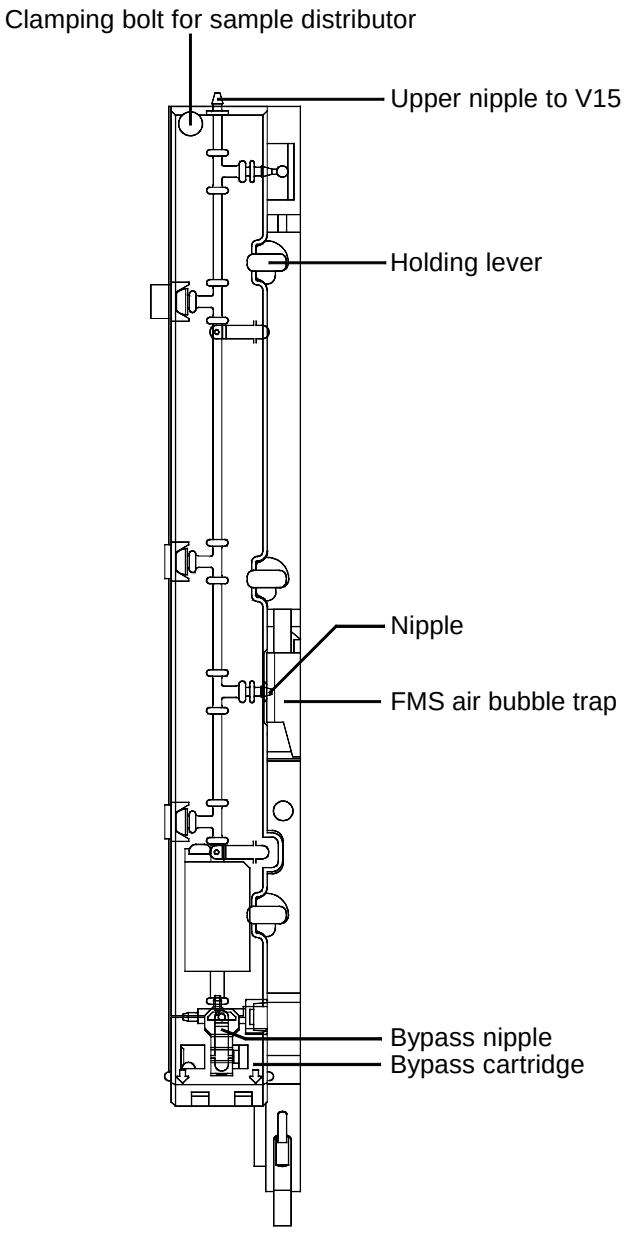


Fig. 55: Sample distributor

Changing the sample distributor cartridge

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

When changing the sample distributor cartridge (see Fig. 86, **3**), please proceed as follows:

1. Activate the program "**System - Util - Analyzer Actions - Park Cartridges - SD Cartridge**" to retract all valve tappers.
2. Open the analyzer cover and remove in the upward direction.
3. Open bottle compartment cover.
4. Remove the sample distributor cover (see Fig. 56, **8**).
5. Pull sample drip tray down and out (see Fig. 56, **6**).
6. Remove the fill port adapter (see Fig. 56, **5**) by turning it downwards.
7. Remove the T&D cover by pressing the lower edges in an upward direction and pull it off toward the top.
8. Remove the sample inlet path (see Fig. 56, **4**).
9. Push the bypass cartridge (see Fig. 56, **b**) in the direction of the arrow downwards and remove the bypass nipple (see Fig. 56, **a**).
10. Pivot the FMS air bubble trap (see Fig. 56, **3**) towards the right outside.

NOTE: *Make sure that the FMS air bubble trap is fully swiveled out to make the nipple accessible.*

11. Pull off the tube from the SD cartridge (see Fig. 56, **1**).

NOTE: *Be careful when removing and attaching the tube at the upper nipple to V15.*
Do not use a sharp-edged pair of tweezers to pull off the tube.

12. Release the SD cartridge by turning the 3 holding levers (see Fig. 56, **2**) 90° to the left.
13. Lift the SD cartridge on the right upper end and rotate outwards.

Assembly is done in reverse order.

NOTE: *Make sure that the L-elastomer (top right on the sample distributor cartridge) is placed properly on the sample distributor block (AVL OMNI™ 7-9 only).*

After reassembling a SD cartridge confirm the information on the screen with "**Continue**" and change back into the "**Ready**" - screen.

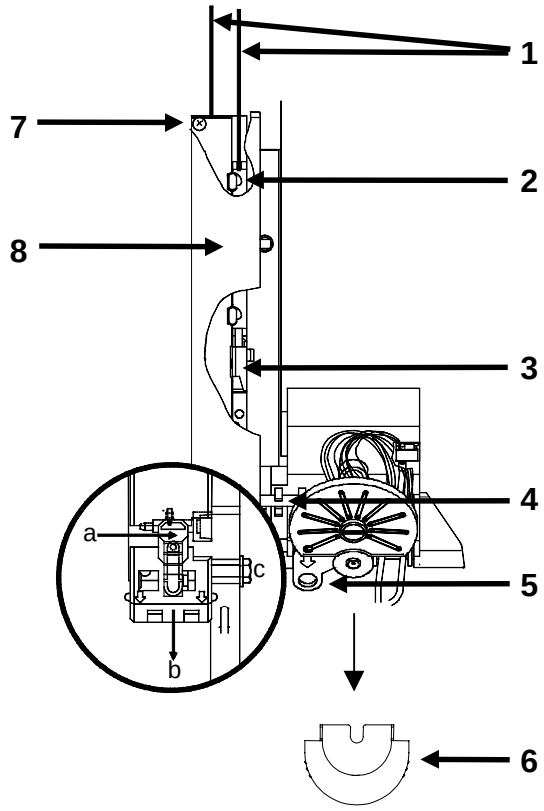


Fig. 56: Sample distributor and Bypass cartridge

Changing the entire sample distributor

When changing the sample distributor (see Fig. 86), please proceed as follows:

1. With the help of the shutdown tubing set, put the AVL OMNI™ out of operation (see Chapter 4 under "Shutdown").
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Open up the PP cover.
4. Pull sample drip tray down and out (see Fig. 56, **6**).
5. Remove the fill port adapter (see Fig. 56, **5**) by turning it downwards.
6. Remove the T&D cover by pressing the lower edges in an upward direction and pull it off toward the top.
7. Remove the T&D sample inlet path (see Fig. 56, **4**).
8. Push the bypass cartridge (see Fig. 56, **b**) in the direction of the arrow downwards and remove the bypass nipple (see Fig. 56, **a**).
9. Pivot the FMS air bubble trap (see Fig. 56, **3**) towards the right outside.

NOTE: *Make sure that the FMS air bubble trap is fully swiveled out to make the nipple accessible.*

10. Pull off the tube (see Fig. 56, **1**) from the sample distributor and the SD cartridge.

NOTE: *Be careful when removing and attaching the tubing at the upper nipple to V15.*
Do not use a sharp-edged pair of tweezers to pull off the tube.

11. Release the SD cartridge by turning the 3 holding levers (see Fig. 56, **2**) 90° to the left.
12. Lift the SD cartridge on the right upper end and rotate outwards.
13. Disconnect the electrode plugs (black and white, see Fig. 32) from the MC cartridge.
14. Open the following screws:
    - Holding screw for the sample distributor (see Fig. 56, **7**)
    - 2 screws on the side of each measuring chamber
    - screw on the side of the sample distributor (see Fig. 56, **c**)
15. Remove the cover(s) above the BG measuring chamber, by opening the Phillips screw.
16. Remove the MC cartridge (see page 5-71), when the analyzer still has a measuring chamber, which does not have space for the measuring chamber output tubes.
17. Gain access to the rear of the analyzer.
18. Disconnect all cables, optical light guides and groundings from the sample distributor or from the Main- and Motherboard and remove the entire unit from beneath.

Assembly is done in reverse order.

NOTE: *Make sure that the L-elastomer (top right on the sample distributor cartridge) is placed properly on the sample distributor block (AVL OMNI™ 7-9 only) when reassembling the SD cartridge.*

Do not exchange the two tubes on the sample distributor when reconnecting.

Before replacing the electrode plugs clean their coupling piece on the measuring chamber with cotton swab.

Changing the optical sensors at sample distributor

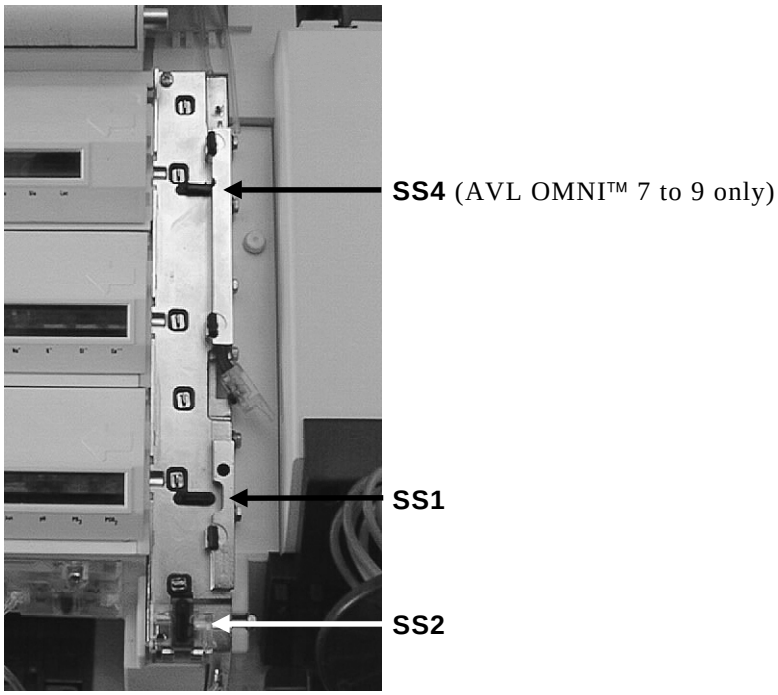


Fig. 57: Optical sensors (sample sensors) at sample distributor

When changing the optical sensors (sample sensors) at sample distributor (SS1, SS2 and SS4), please proceed as follows:

Optical sensor SS1:

1. Disassemble the SD cartridge as described on page 5-122).
2. Switch off the AVL OMNI™.
3. Disconnect all cables (power cable, barcode, etc.) from the AVL OMNI™.
4. Tip the screen in the forward direction.

5. Pull off the tubes **1**, **2**, and **3** (see Fig. 58) from the sample distributor.

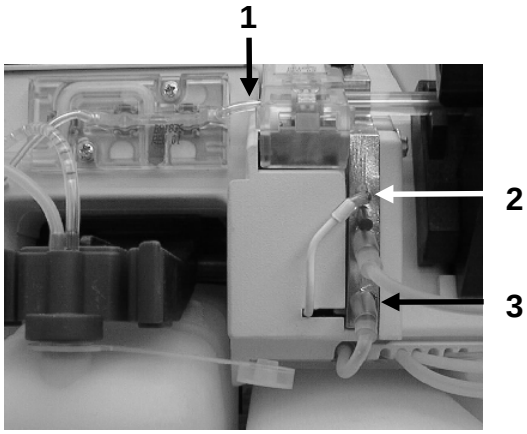


Fig. 58: Sample distributor

6. Open the Phillips screws on the back of the analyzer.
7. Remove the rear panel diagonally in the upward direction.
8. Remove the grounding plug from the rear panel.
9. Unscrew the two Phillips screws, which hold the measuring chamber, plate, and pull up until it clicks into place.
10. Gain access to the rear of the analyzer.
11. Remove V25 (VBI) as described on page 5-148.
12. Disconnect the optical sensor from the Mainboard.
13. Remove the sample sensor from the sample distributor.

Assembly is done in reverse order.

Optical sensor SS2:

1. Disassemble the bypass cartridge as described on page 5-27.
2. Remove the sample sensor from the bypass cartridge.

Assembly is done in reverse order.

Optical sensor SS4 (AVL OMNI™ 7 to 9 only)**:**

1. Disassemble the SD cartridge on page 5-122).
2. Switch off the AVL OMNI™.
3. Disconnect all cables (power cable, barcode, etc.) from the AVL OMNI™.
4. Tip the screen in the forward direction.
5. Pull off the tubes **1**, **2**, and **3** (see Fig. 58) from the sample distributor.
6. Open the Phillips screws on the back of the analyzer.
7. Remove the rear panel diagonally in the upward direction.
8. Remove the grounding plug from the rear panel.
9. Unscrew the two Phillips screws, which hold the measuring chamber, plate, and pull up until it clicks into place.
10. Gain access to the rear of the analyzer.
11. Remove V29 (VSI) as described on page 5-149.
12. Disconnect the optical sensor from the Mainboard.
13. Remove the sample sensor from the sample distributor.

Assembly is done in reverse order.

Thermal printer

Changing the thermal printer

When changing the thermal printer (see Fig. 5-30, **3**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under „General information on assembly and disassembly of components“.
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the 26-poled flat cable (data line) from the thermal printer.
5. Remove screen grid (only from SN 2000 on).
6. Unscrew the 4 Phillips screws, which hold the thermal printer and remove.
7. Align the new thermal printer in the center of the paper shaft and attach loosely, so that the position can still be changed.
8. Place the measuring chamber plate into its original position.
9. Switch on the AVL OMNI™.

Caution! - When handling the AVL OMNI™ with its rear panel removed.

10. During the warm-up phase, activate the function program "**Options**".
11. Insert the printer paper as follows:

NOTE: *The printer paper is heat sensitive on one side only. Ensure that the paper roll is inserted properly.*

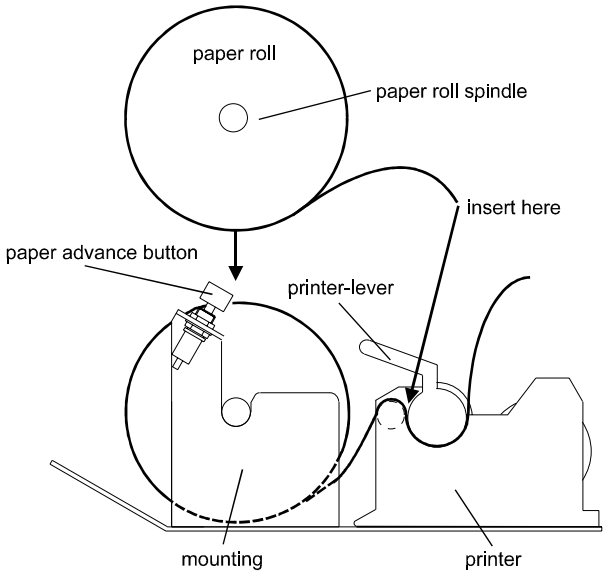


Fig. 59: Inserting printer paper

a) Remove the paper roll spindle.
b) Put the new paper roll on the spindle.
c) Insert the paper roll in the printer and press down carefully.
d) Cut the paper edge at a right angle.
e) Push the printer lever down.
f) Thread the paper edge behind the upper rubber roller.
g) Adjust the paper in the center of the rubber roller.
h) Pull the printer lever up.
i) Press the paper advance button until the paper comes out of the print slot.
j) Activate a few printouts under "**Reports**" and tear off the paper after each printout to make sure that the paper is fed straight through the center of the paper feeder.

If necessary, move the thermal printer in its attachment holes to center it in the paper shaft.

12. Switch off the AVL OMNI™.
13. Screw on the thermal printer.

Assembly is done in reverse order.

lf the paper take-up unit (optional) is installed on the rear panel of the AVL OMNI™ place the printer paper on the spindle and push the three-prong spool over it.

T&D system

Function

The T&D module is a filling and distribution system with 11 possible inputs and one output and serves for the correct selection of calibration fluids, wash solutions and the sample. It supplies the measuring chamber with the desired fluid.

It generally consists of 5 functional units:

- **Lifting device of the distribution disk (docking and docking-off movement):**
  The distribution disk can be moved towards the outside with a stepper motor and an eccentric disk.
- **Rotation device of the distribution disk:**
  The disk can be turned in desired positions with a stepper motor on the rear end of a shaft.
- **Sample container detection:**
  The insertion of a sample container is identified by an infra-red light barrier in front of the fill port allowing automatic reaction by the analyzer. This light barrier controls the lifting and rotation movements of the disk.
- **Sample sensors (SS4, SS6):**
  The sample sensors are only fixed mechanically to the T&D module. The control or scanning in of the sensors takes place on the Mainboard.

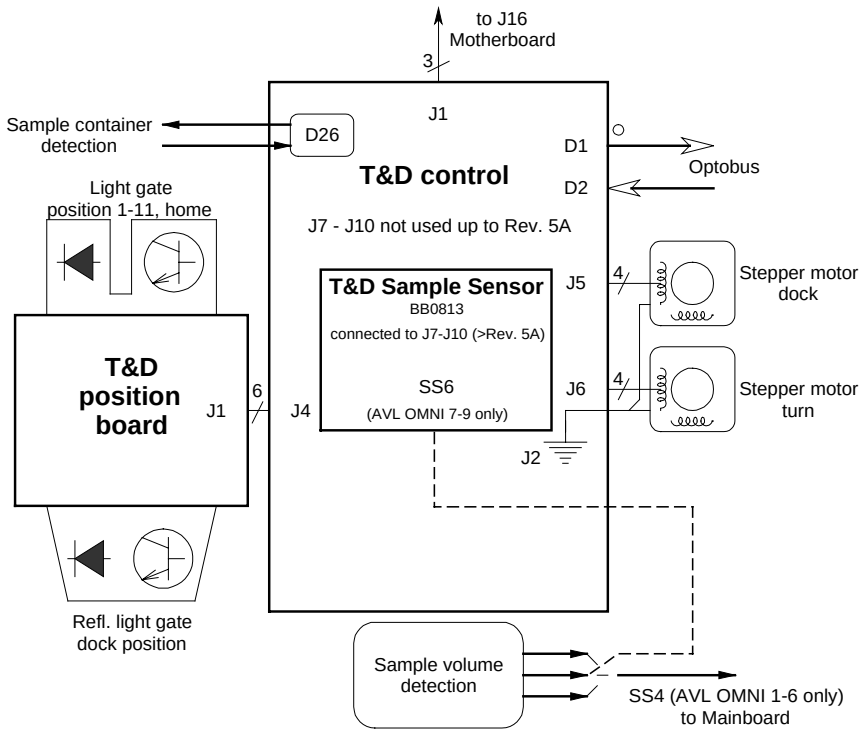


Fig. 60: Wiring - T&D system

Electronics

The electronics consist of 2 parts:

- **T&D control** (see Fig. 62 and Fig. 87):
  The T&D control is assembled on the inner side of the measuring chamber plate above the T&D system.
- **Sensorprint:**
  This print is not visible from the outside and is integrated in the mechanical components acting as holder for two light barriers and a flat cable.

The T&D module is a microcontrolled module, which communicates over the Optobus with the Main control etc. The power supply is connected at J1.
For the turning and for the docking motions a respective stepper motor is provided. The turning motion is controlled with a transmissive photo-interrupter, the docking movement with a reflex light barrier. Both light barriers are located on a small board (T&D positioning board).
The detection of the sample (type) is performed with the help of optical light guides, which are connected to D26 on the T&D control. Further, 3 optical light guide sensors are provided in the T&D module, which differ from one analyzer version (AVL OMNI™ 1-9) to the other (see also Fig. 63 and chapter 7, section "Sample input").

SS positions:

AVL OMNI™ 1	SS4 (right)
AVL OMNI™ 2, 3	SS4 (left)
AVL OMNI™ 4	SS4 (center)
AVL OMNI™ 7 to 9	SS6 (center)

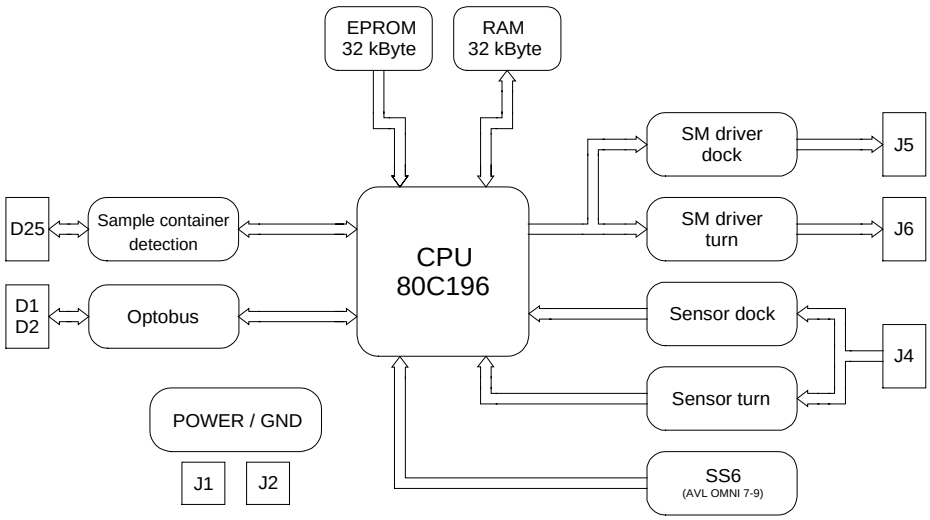


Fig. 61: Block diagram - T&D control

Software

Behavior after reset

The T&D disk is driven to position 1 after a series of self-calibration steps have been made.

Software update

Please change the EPROM I17 on the T&D-control (see Fig. 62) to perform a software update.

Determining the software revision

- Information on the display of the AVL OMNI™ under "**Options - AVL Support**" or "**System - Test - Component Test - Aggregates - T&D System - T&D Info**".
- The up to date software revision is located on EPROM I17 (see Fig. 62).
- The storage areas locations 7F00-7F08 can be read out by using a programming device (For example, "T&D V0535" for version 5 revision 35).

Binding into AVL OMNI™ software

The T&D module is controlled exclusively from the Mainboard over the internal optical connection. Exceptions are the adjustment procedures immediately after reset and the identification of a capillary or syringe (message to Mainboard, which initiates all further steps), which are performed automatically.

Adjustment procedures

The following adjustment steps are automatically performed by the module, immediately after turning on or /Reset.

- **Adjusting the sensor for the docking-off mechanism:**
  The T&D disk is docked off and the course of the sensor signal for laying down criteria for decisions is recorded.
- **Adjusting the sample container detection:**
  The T&D disk is turned to position 2 and 0 to identify signals which occur during interruption or free light barriers. These two values are necessary for the identification of a capillary at a later time. If the module functions properly, the T&D disk stops in position 1 until the PC starts the Mainboard.

SS6 is calibrated before each action.

Changing the T&D module

Electrostatic Sensitive Device

When changing the entire T&D module (see Fig. 86, **6**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Pull sample drip tray down and out.
4. Press the T&D flap (see Fig. 86, **7**) downward.
5. Remove the fill port adapter (see Fig. 65) by turning it downward.
6. Remove the T&D sample inlet path (see Fig. 86, **5**).
7. Gain access to the rear of the analyzer.
8. Disconnect all (excluding D1, D2 and J1) connections from the T&D control (see Fig. 62) and SS4 from the Mainboard.
9. After unscrewing the 4 Phillips screws on the T&D module (on the front of the analyzer) the T&D module can be removed.

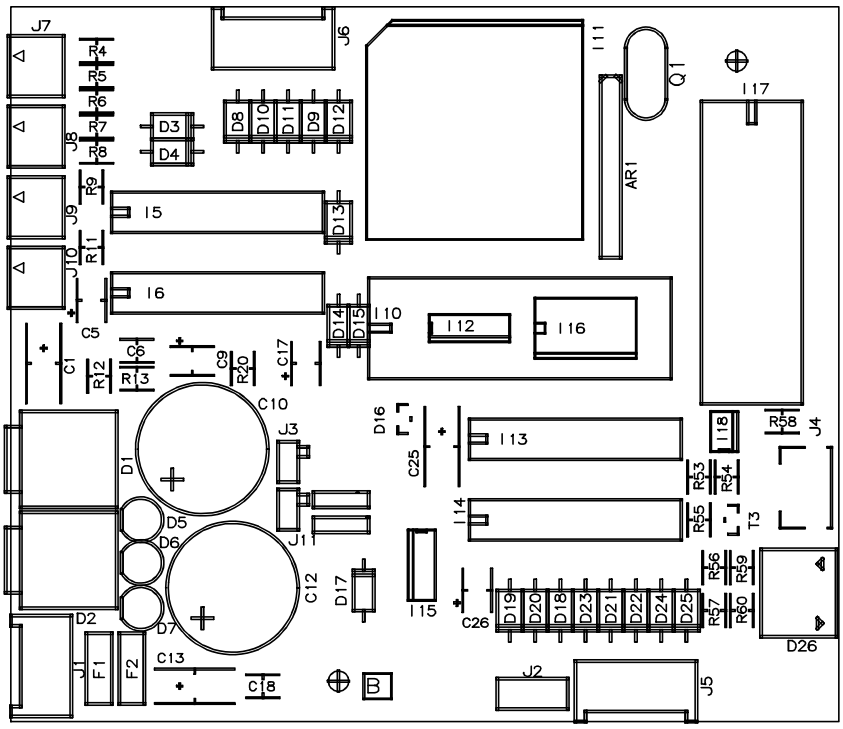


Fig. 62: T&D control (without T&D sample sensor board)

Assembly is done in reverse order.

Changing the optical sensors SS4 or SS6

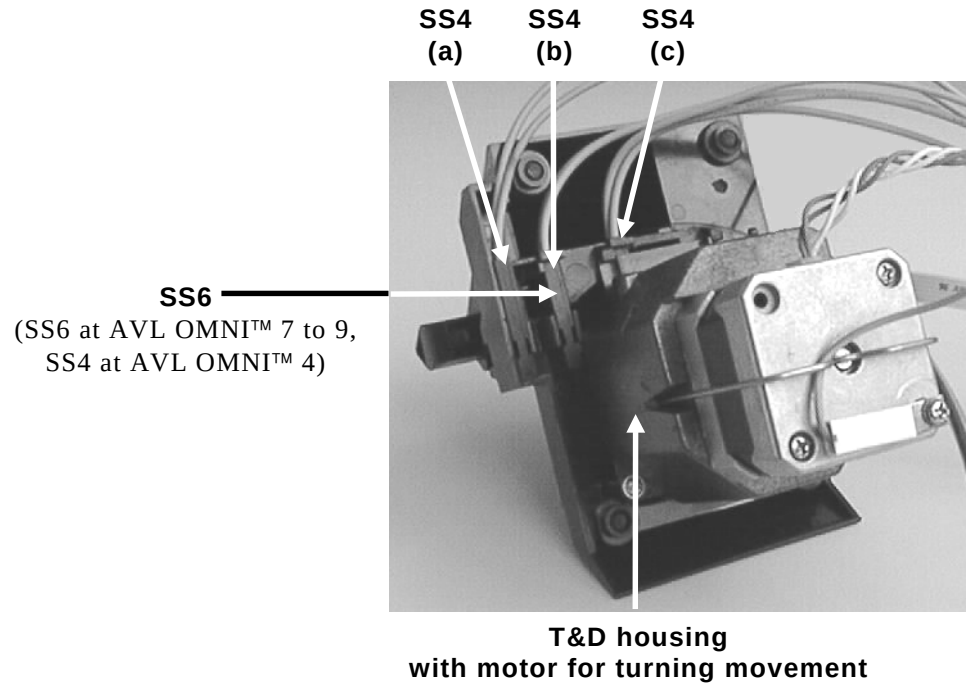


Fig. 63: Optical sensors (sample sensors) in the T&D module

When changing the optical sensors (sample sensors) in the T&D module, please proceed as follows:

Optical sensor SS4 (a and b) or SS6:

1. Disassemble the T&D module as described on page 5-133).
2. With a screwdriver, push the snap hooks aside and remove the sample sensor.
3. Remove the label from the old sample sensor and attach it to the new sensor.

Assembly is done in reverse order.

Optical sensor SS4 (c):

1. Disassemble the T&D module as described on page 5-133).
2. Remove the bracket from the motors and remove the motors from the T&D module.
3. Disassemble the housing of the T&D module by removing the two screws.
4. With a screwdriver, push the snap hooks aside and remove the sample sensor.
5. Remove the label from the old sample sensor and attach it to the new sensor.

Assembly is done in reverse order.

NOTE: *After reinstalling the motor for the lifting movement, the shaft of the T&D module must be freely moveable. To ensure that this is the case, pull the shaft forward during installation of the motor (for end position shaft see Fig. 64).*

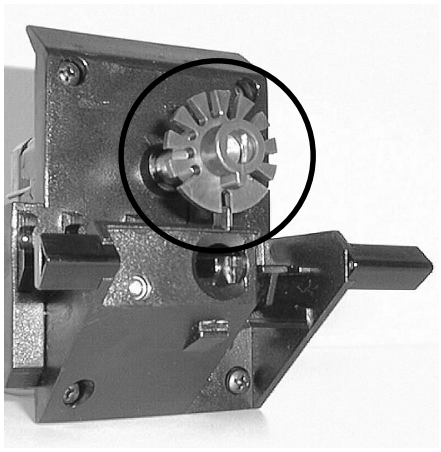


Fig. 64: End position shaft - T&D

Changing the tubing set and the disk

When changing the tubing set and/or the T&D disk, please proceed as follows:

1. To prepare for changing, activate the program "**System - Test - Component Test - Aggregates - T&D System - Changing Tubes**".
2. Open the analyzer cover and remove in the upward direction.
3. Open the bottle compartment cover.
4. Pull sample drip tray down and out.
5. Remove the fill port adapter by turning it downward.
   The fill port adapter can now be used as a tool. Insert the area marked with the arrow into the slit of the holding disk and turn the holding disk a fourth of a turn to the right or left, in the same way as with a screw driver. At the same time, hold the T&D disk firmly (see Fig. 65).

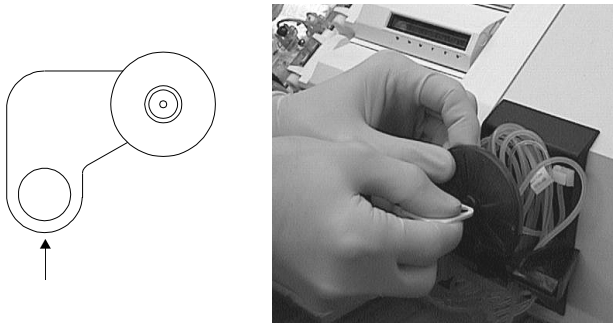


Fig. 65: Fill port adapter with fill port

6. Remove the T&D cover by pressing the lower edges in an upward direction and pull it off toward the top.
7. Press the T&D flap (Fig. 86, **7**) downward.
8. The T&D tubing and/or the T&D disk can now be exchanged.

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

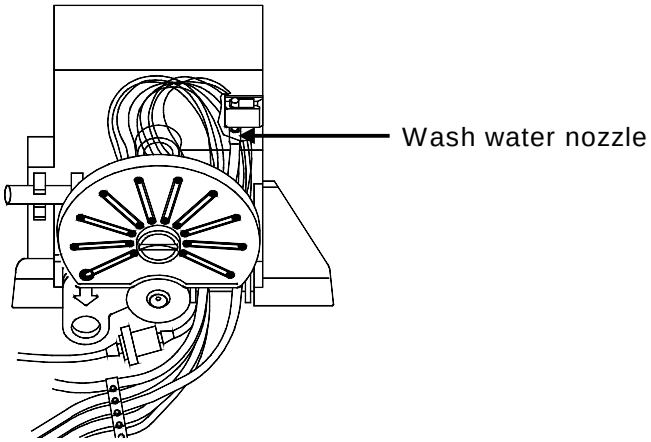
Assembly is done in reverse order.

NOTE: *When reassembling the T&D tubing, pay attention to the color-coding and the correct position of the wash water nozzle (see Fig. 66, **a**).*

T&D disk and fill port adapter must always have revision level ≥ 01.

After reassembling the tubing set and/or the disk confirm the information on the screen with "**Exit**".
If the position of the T&D disk is centered, confirm with "**Yes**" and change back to the "**Ready**" - screen.

a



b

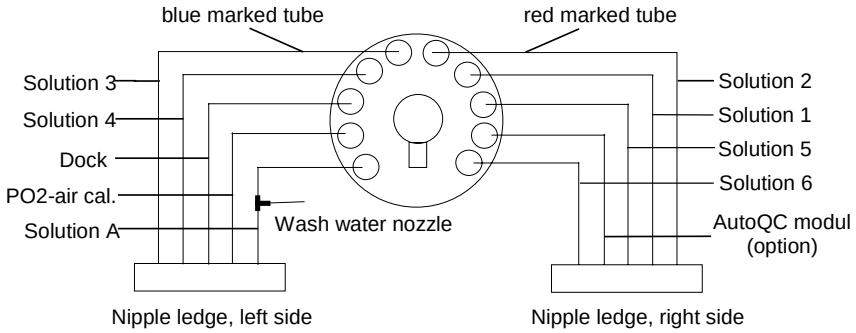


Fig. 66: T&D disk / Wash water nozzle / Nipple ledge

After a possible change of the stepper motors, the following adjustment is to be performed:

1. After a stepper motor has been changed, switch on the AVL OMNI™.
2. Call-up "**System**".
3. Remove the holder from the shaft.
4. Call-up the test program "**Test - Component Test - Aggregates - T&D System - Changing Tubes**".
   The shaft is centered at position 0 by the controller and is then held in this position with the stepper motors (for a maximum of 3 minutes).
5. Assemble the holder so that the slit located somewhat offside, rests in the guiding; the Allan head screw points to the right.
6. Press "**Exit**".
   The shaft is centered once again by the controller and must rest into the guiding as exactly as possible. If this does not occur, press "**No**" and repeat this adjustment.

Vacuum pump

Function

The vacuum pump (+24 V DC) provides the necessary under-pressure of approx. 700 mbar, which guarantees appropriate washing and drying of the measuring channel. For operational safety, we suggest to renew the pump head (housing part and membrane), once a year.

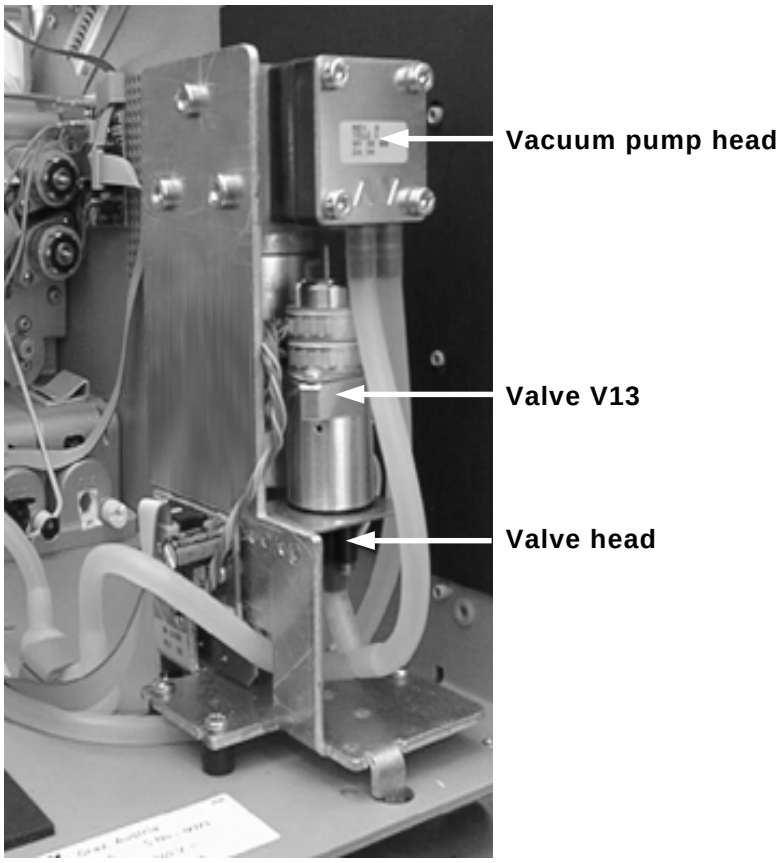


Fig. 67: Vacuum pump

Changing the vacuum pump

When changing the vacuum pump (see Fig. 67), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect all cables and tubes from the vacuum pump.
5. Loosen the three Phillips screws, which hold the vacuum pump.

Assembly is done in reverse order.

Changing the vacuum pump head, valve head and valve tapper

When changing the vacuum pump head, please proceed as follows:
Switch off the AVL OMNI™.

1. Open the Phillips screws on the back of the analyzer.
2. Remove the rear panel diagonally in the upward direction.
3. Remove the grounding plug from the rear panel.
4. Gain access to the rear of the analyzer.
5. Pull off the tubes from the vacuum pump.
6. Open the 4 screws on the vacuum pump head and the 2 screws on the valve head.
7. Remove the valve and pump head.

For disassembling the valve tapper, loosen and remove both Allan head screws on the valve head.

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Assembly is done in reverse order.

Vacuum sensor

Function

The vacuum sensor checks the under pressure in the vacuum system. This is performed by a piezoresistive vacuum sensor, which measures the pressure between the vacuum pump and the Waste container.

Changing the vacuum sensor

When changing the vacuum sensor (see Fig. 87), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Pull off the tube from the vacuum sensor.
5. Disconnect the connecting cable from the Motherboard.
6. Loosen the holding screws.

Assembly is done in reverse order.

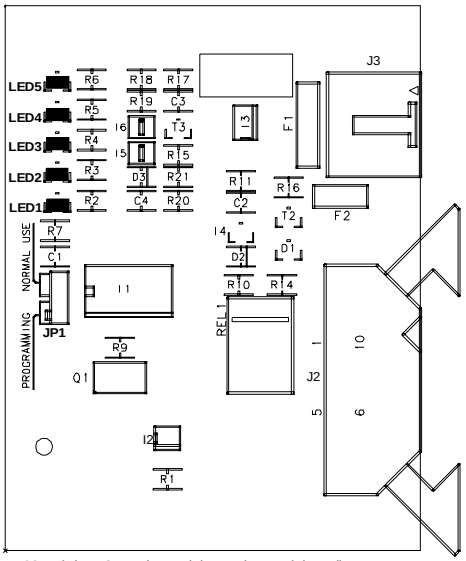
Valves

(applicable from SN 5000 on; for SN < 5000, see chapter 10, Manual revision 8.0)

Wiring of the valves

One flat cable, the so-called valve bus goes from the Aktuator control board to seven different actuator boards, which are used to control the individual valves (see Fig. 68). The actuator boards are located immediately next to the respective valve.
The valves are also controlled by a sequential circuit to keep down the load on the power supply unit.

LED's on the Aktuator control board signal special valve malfunctions. A troubleshooting description can be found in chapter "Troubleshooting" under "Valve problems".



BB0854 (Aktor Control Board, located on Mainboard)

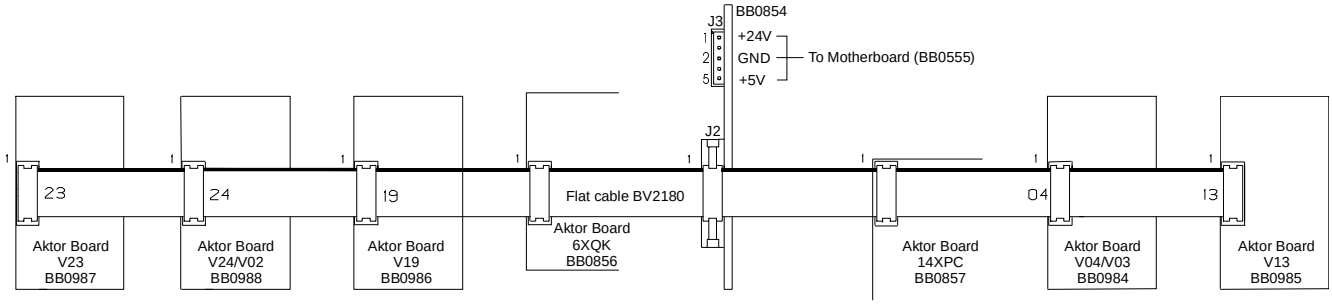


Fig. 68: Valve bus

NOTE: *Jumper **J1** must be set to "**NORMAL USE**".*

Bottle compartment						SD cartridge							tHb cartridge			MC cartridge									PP cartridge						
V13	V3	V4	V19	MIX	V22	VBI	V21	VII	VSI	V20	V24	V2	V23	VBO	V7	V5	VIO	V11	V9	V8	VSO	V15	V17	V16	V14	Id. No.	BP2475 service kit for linear actuators
																										BP2430	valve actuator
																											bell housing
																											bell housing (long)
																											adapter (short)
																											adapter bypass
																											adapter long
																											adapter extension (short)
																											adapter extension
																											adapter (large)
																											valve tapper
																											spindle adapter M3x20ia
																											spindle adapter M3x25ia
																											spindle adapter M3x8ia
																											spindle adapter M3x50ia
																											LA spindle key
																											mounting tool
																										YB2236	actuator holder 6 SD
																										YB2237	bracket bypass
																										YB2238	PP plate
																										YB2239	MC plate
																										YB2240	bracket actuator SD
																										YB2241	bracket actuator bypass
																										BP1644	FMS valve (Mix)
																										EP0329	spacer M3x25ii
																										EP0053	distance holder M3x15ia
																										EP0237	distance holder M3x40ia
																										EP0370	spacer M3x27ii
																										EP0371	spacer M3x27ia

																										BB0854	Aktor Control Board					
																										BB0987	Aktor Board V23					
																										BB0988	Aktor Board V24/V02					
																										BB0986	Aktor Board V19					
																										BB0856	Aktor Board 6XQK					
																										BB0857	Aktor Board 14XPC					
																										BB0984	Aktor Board V04/V03					
																										BB0985	Aktor Board V13					
																										BV2311	valve supply cable					
																										BV2180	valve bus cable					

Tab. 1: Valve and valve bus components

VBI = V25
VBO = V26
VII = V27
VIO = V28
VSI = V29
VSO = V30

In instruments without tHb/COOX-, ISE- and/or MSS module, the respective valves are not applicable.

Changing the valve units

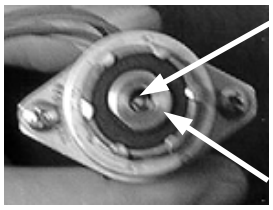
For valve positions, please see tubing diagram in chapter “Functional procedures“.

General information

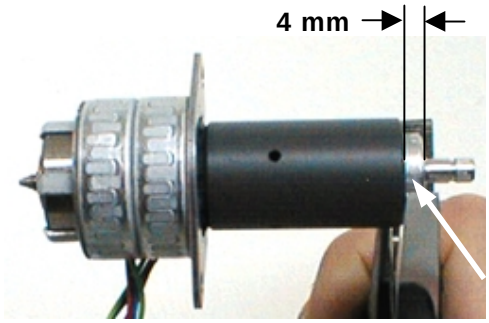
The components of the valves and/or valve units may vary (see also Tab. 1, page 5-142).
To be able to disassemble a valve unit if needed, remove the bell housing.

Procedure:

1. Turn the brass disk until the bell housing is moved out for **max. 4mm**. Use tool LA spindle key **VD0347** to facilitate this procedure.

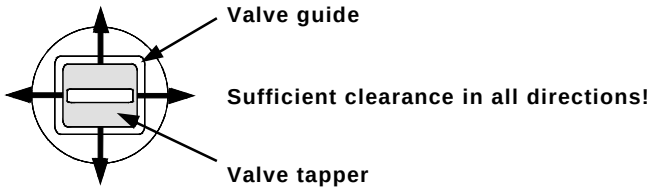


2. Use pliers to loosen the bell housing and unscrew it.



The assembly tool **YB2367** is used for fastening and releasing the spindle adapter of valves V5, V8, V9, V15, V16, V20, V21, V22, V23, V24, VBI, VII, VSI and VBO.

NOTE: *When assembling the bell housing, bring the motor spindle in a position where the bell housing is not moved out more than 4 mm after assembly.*
*The spindle must be moved in **completely** after installation of the bell housing to avoid damage to the cassettes.*
Pay particular attention to valve clearance and adjust with fastening screws, if necessary:



(View: front of instrument with cassette removed).

Never connect or disconnect valves, Aktuator control board and Aktuator boards, when the instrument is connected to power.

Ensure correct valve connections on the Aktor boards.
Valve connector positions are printed on Aktor boards 6XQK and 14XPC, for connector positions for all other boards, please refer to the table below:

	Connector	
Valve	**J2**	**J3**
V23	•	
V24	•	
V02		•
V19	•	
V04	•	
V03		•
V13	•	

Bottle compartment group

Valve type

Valves **V3**, **V4**, **V13** and **V19** have the following composition:

1..... valve actuator
2..... adapter (large)
3..... bell housing (long)

Fig. 69: Valve type 1 - V3, V4, V13, V19

Changing V3 or V4

In any case refer to “General information” on page 5-143.

When changing **V3** and/or **V4** please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Remove the two Phillips screws and take off the valve head (=instrument specific; see Fig. 70).
4. Remove the valve cap (see Fig. 70), by pushing it to the side firmly in the direction of the arrow.
5. Remove the clamping part (see Fig. 70).
6. Gain access to the rear of the analyzer.
7. Disconnect the respective valve connector from Aktor Board BB0984.
8. Unscrew the two fastening screws.
9. Remove the shock absorbing ring, the valve plate and the valve head.

Assembly is done in reverse order.

NOTE: *When reassembling the valve, pay attention that the shock absorbing ring is exactly seated in the valve recess and the tube lies under the clamping part.*

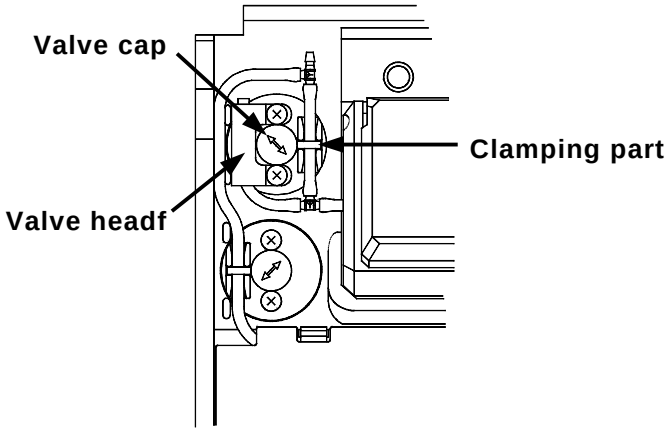


Fig. 70: V3 and V4 (AVL OMNI™ 2, 3, 5, 6, 8 and 9)

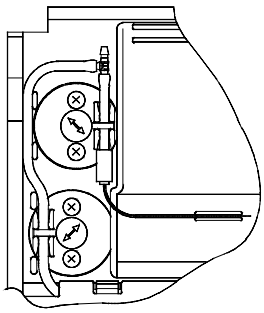


Fig. 71: V3 and V4 (AVL OMNI™ 1, 4, and 7)

Changing V13 (Vacuum pump)

In any case refer to “General information” on page 5-143.

When changing **V13** please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the valve connector from Aktor Board BB0985.
5. To facilitate disassembly, remove the pump holder.
6. Remove the two fastening screws from the valve head (see Fig. 67) and take out the valve unit.

Assembly is done in reverse order.

Changing V19 (FMS)

In any case refer to “General information” on page 5-143.

When changing **V19** please proceed as follows:

1. Remove the FMS system as described on page 5-42.
2. Disconnect the valve connector from Aktor Board BB0986.
3. Remove the two Phillips screws and take off the valve head (see Fig. 72).
4. Remove the valve cap (see Fig. 72), by pushing it down firmly in the direction of the arrow.
5. Remove the clamping part (see Fig. 72).
6. Remove the two fastening screws and take out the valve unit.

Assembly is done in reverse order.

Changing Mix valve

In any case refer to “General information” on page 5-143.

When changing the FMS Mix valve please proceed as follows:

1. Remove the FMS system as described on page 5-42.
2. Disconnect the valve connector from the valve unit.
3. Remove the valve cap (see Fig. 72), by pushing it down firmly in the direction of the arrow.
4. Remove the clamping part (see Fig. 72).
5. Remove the two fastening screws and take out the valve unit.

Assembly is done in reverse order.

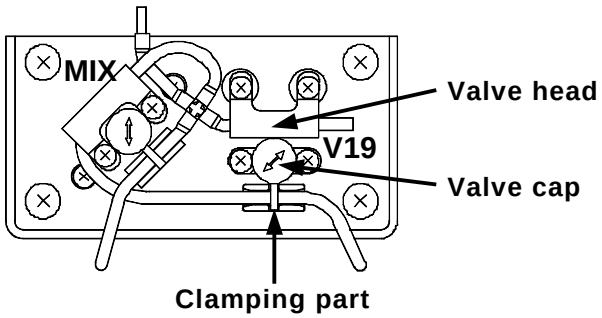
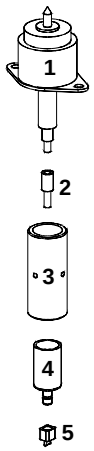


Fig. 72: V19 and Mix valve

Sample distributor group

Valve types

Valves **V22**, **V25** (VBI) and **V21** have the following composition:



1 ..... valve actuator
2 ..... spindle adapter M3x25ia
3 ..... adapter (long)
4 ..... bell housing
5 ..... valve tapper

Fig. 73: Valve type 2 - V22, V25 (VBI), V21

Changing V22, V25 (VBI), V21

In any case refer to “General information” on page 5-143.

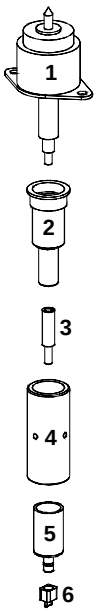
When changing **V22**, **V25** (VBI) and/or **V21** please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the respective valve connector from Aktor Board BB0856.
5. Remove the two fastening screws and take out the valve unit.

Assembly is done in reverse order.

NOTE: *Test the switching function of the valves by switching the respective valve under “**System - Test – Component Test – Valves**“. When the valve is closed, the valve plunger must be clearly visible through the cassette.*

Valves **V27** (VII), **V29** (VSI) and **V20** have the following composition:



1..... valve actuator
2..... adapter extension (short)
3..... spindle adapter M3x20ia
4..... adapter (long)
5..... bell housing
6..... valve tapper

Fig. 74: Valve type 3 - V27 (VII), V29 (VSI), V20

Changing V27 (VII), V29 (VSI), V20

In any case refer to “General information” on page 5-143.

When changing **V27** (VII), **V29** (VSI) and/or **V20** please proceed as follows:

1. Remove the sample distributor as described on page 5-123.
2. Disconnect the respective valve connector from Aktor Board BB0856.
3. Remove the two fastening screws and take out the valve unit.

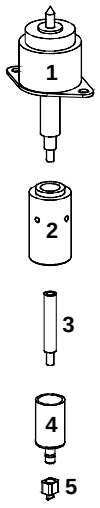
Assembly is done in reverse order.

NOTE: *Test the switching function of the valves by switching the respective valve under “**System - Test – Component Test – Valves**“. When the valve is closed, the valve plunger must be clearly visible through the cassette.*

tHb cartridge group

Valve types

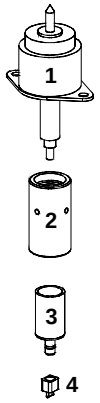
Valves **V23** and **V24** have the following composition:



1 ..... valve actuator
2 ..... adapter bypass
3 ..... spindle adapter M3x25ia
4 ..... bell housing
5 ..... valve tapper

Fig. 75: Valve type 4 - V23, V24

Valve **V2** has the following composition:



1 ..... valve actuator
2 ..... adapter (short)
3 ..... bell housing
4 ..... valve tapper

Fig. 76: Valve type 5 - V2 (as well as V30 (VSO), V11, V28 (VIO), V7 and V14)

Changing V23, V2, V24

In any case refer to “General information” on page 5-143.

When changing **V23**, **V2** and/or **V24** please proceed as follows:

1. Remove the Waste cap as described on page 5-40 from item 2 on.
2. Disconnect the respective valve connector from Aktor Board BB0987 (V23) or BB0988 (V24).
3. Remove the two fastening screws for the valve bracket (see Fig. 77) and take out the entire unit.

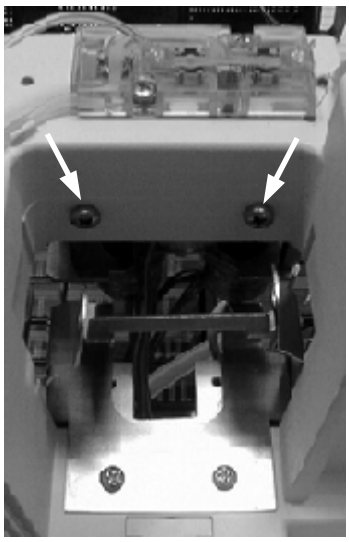


Fig. 77: Valve bracket

4. Remove the bell housing as described on page 5-143.
5. Remove the two fastening screws of the respective valve actuator and take out the valve unit.
   For disassembly of V2 slightly loosen the upper fastening screws of V23 and V24 .

Assembly is done in reverse order.

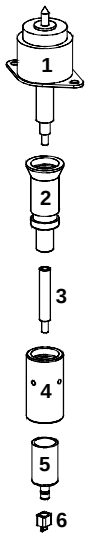
NOTE: *Test the switching function of the valves by switching the respective valve under “**System - Test – Component Test – Valves**“. When the valve is closed, the valve plunger must be clearly visible through the cassette.*

MC cartridge group

Valve types

For composition of valves **V30** (VSO), **V11**, **V28** (VIO) and **V7** refer to Fig. 76, page 5-150.

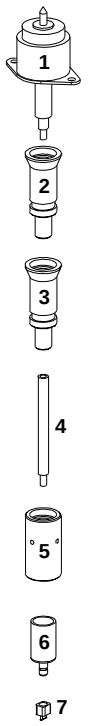
Valves **V26** (VBO), **V5** and **V9** have the following composition:



1 ..... valve actuator
2 ..... adapter extension
3 ..... spindle adapter M3x25ia
4 ..... adapter (short)
5 ..... bell housing
6 ..... valve tapper

Fig. 78: Valve type 6 - V26 (VBO), V5, V9 (as well as V15 and V16)

Valve **V8** has the following composition:



1 ..... valve actuator
2 ..... adapter extension
3 ..... adapter extension
4 ..... spindle adapter M3x50ia
5 ..... adapter (short)
6 ..... bell housing
7 ..... valve tapper

Fig. 79: Valve type 7 - V8

Changing the MC cartridge valves

In any case refer to “General information” on page 5-143.

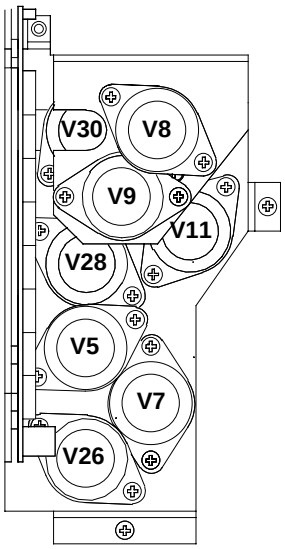


Fig. 80: Measuring chamber cartridge valves on valve bracket

When changing **V26** (VBO), **V7**, **V5**, **V9** and/or **V8** please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the respective valve connector from Aktor Board BB0857.
5. Remove the two fastening screws and take out the valve unit.

Assembly is done in reverse order.

NOTE: *Test the switching function of the valves by switching the respective valve under “**System - Test – Component Test – Valves**“. When the valve is closed, the valve plunger must be clearly visible through the cassette.*

When changing **V28** (VIO), **V11** and/or **V30** (VSO) please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove the fastening screws for the valve bracket and take out the entire unit.
5. Remove the bell housing and the adapter as described on page 5-143.
6. Disconnect the respective valve connector from Aktor Board BB0857.
7. Remove the two fastening screws of the respective valve actuator and take out the valve unit.
   For disassembly of V30, Aktuator board BB0857 and V8 must be disassembled.

Assembly is done in reverse order.

NOTE: *Test the switching function of the valves by switching the respective valve under "**System - Test – Component Test – Valves**". When the valve is closed, the valve plunger must be clearly visible through the cassette.*

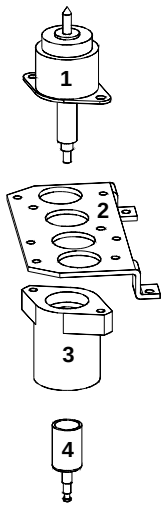
PP cartridge group

Valve types

For composition of valve **V14** refer to Fig. 76, page 5-150.

For composition of valves **V15** and **V16** refer to Fig. 78, page 5-152.

Valve **V17** has the following composition.



1 ..... valve actuator
2 ..... PP plate
3 ..... adapter (maxi)
4 ..... bell housing (long)

Fig. 81: Valve type 8 - V17

Changing V14, V15, V16 V17

In any case refer to “General information” on page 5-143.

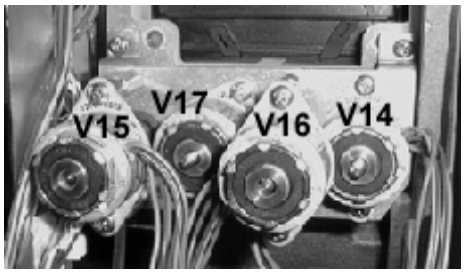


Fig. 82: Valves - PP cartridge

When changing **V14**, **V15**, **V16** and/or **V17** please proceed as follows:

1. Remove the PP cartridge as described on page 5-118.
2. Switch off the AVL OMNI™.
3. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
4. Gain access to the rear of the analyzer.
5. Disconnect the respective valve connector from Aktor Board BB0857.

V14:

- Remove the two fastening screws from V14.
- First disassemble V16 to be able to remove valve unit V14.

V15:

- Remove the two fastening screws from V15 and take out the valve unit.

V16:

- Remove the two fastening screws from V14.
- Remove the two fastening screws from V16 and take out the valve unit.

V17:

- Remove the two fastening screws underneath the PP cartridge.

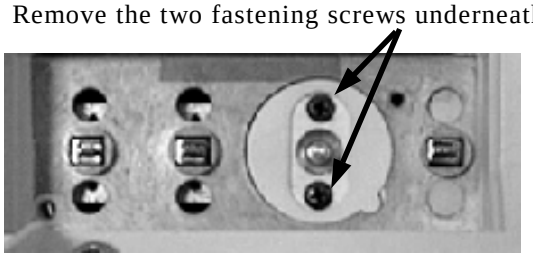


Fig. 83: V17

- Gain access to the rear of the analyzer.
- Remove the two fastening screws for the valve bracket and take out the entire unit.

- Remove the bell housing and the adapter of V17 as described on page 5-143.
- Remove the two fastening screws of V17 and take out the valve unit.

Assembly is done in reverse order.

NOTE: *Test the switching function of the valves by switching the respective valve under "**System - Test – Component Test – Valves**". When the valve is closed, the valve plunger must be clearly visible through the cassette.*

Figures

PC tower - rear view (AT96)

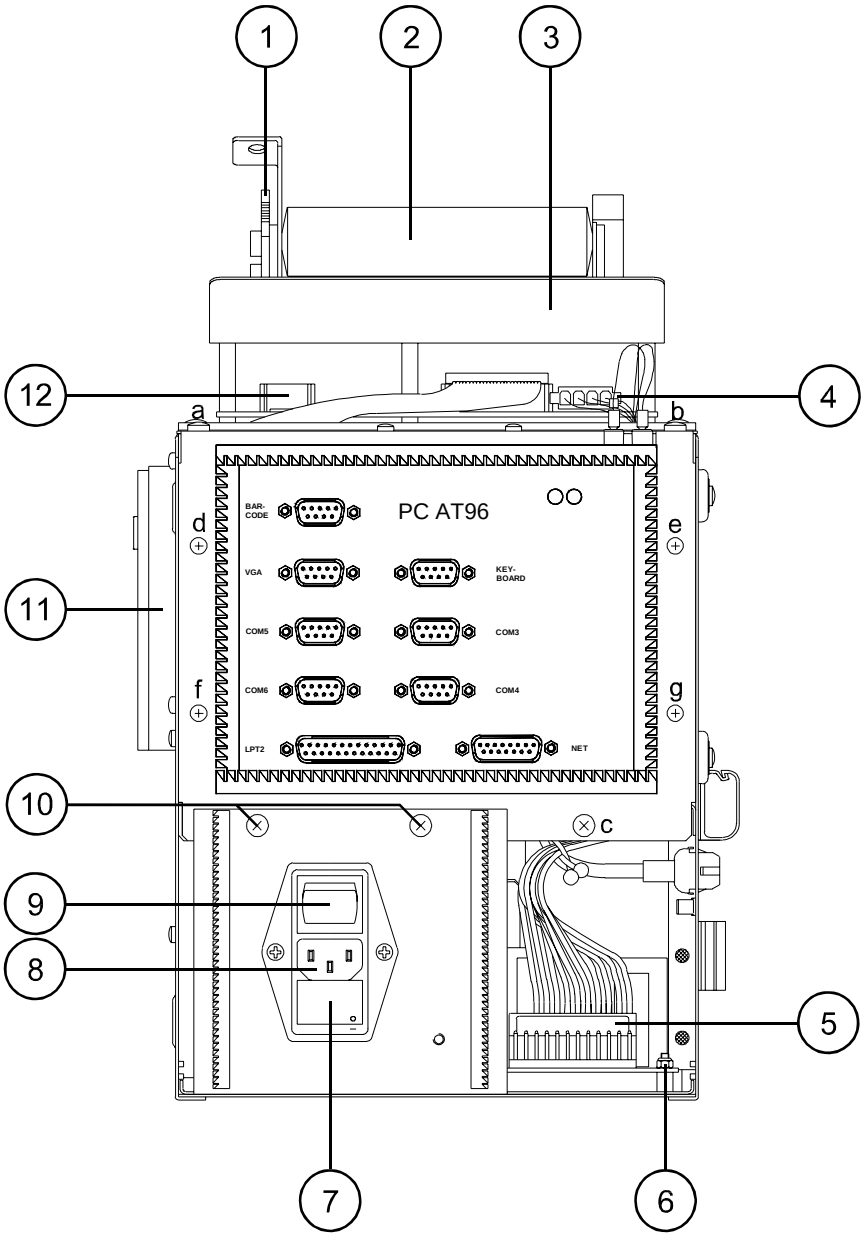


Fig. 84: PC tower / rear view

① ..... Printer lever
② ..... Paper roll axis
③ ..... Thermal printer
④ ..... Power supply - thermal printer
⑤ ..... Power supply - AVL OMNI™
⑥ ..... Fastening screw for power supply unit
⑦ ..... Fuses
⑧ ..... Power supply
⑨ ..... Main switch
⑩ ..... Fastening screws for power supply
⑪ ..... Floppy drive
⑫ ..... Printer dataline

PC tower - topview (AT96)

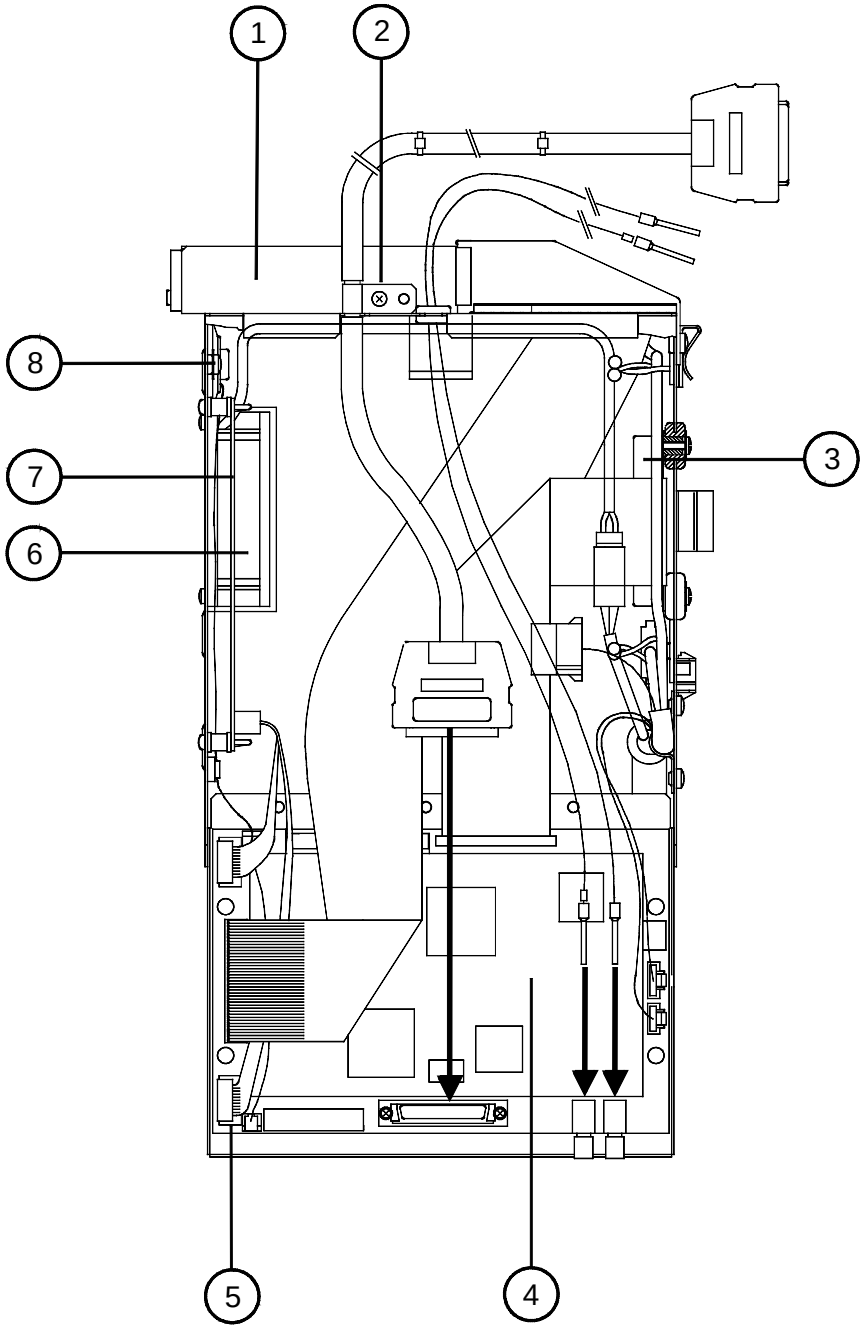


Fig. 85: PC tower / topview

①	Floppy drive
②	Fastening screw for floppy drive
③	Hard disk
④	PC board B486SLC
⑤	AVLIFB
⑥	Fan
⑦	Barcode control
⑧	Buzzer

AVL OMNI™ - front view

Analyzer cover removed, screen disassembled and measuring chamber plate opened up.

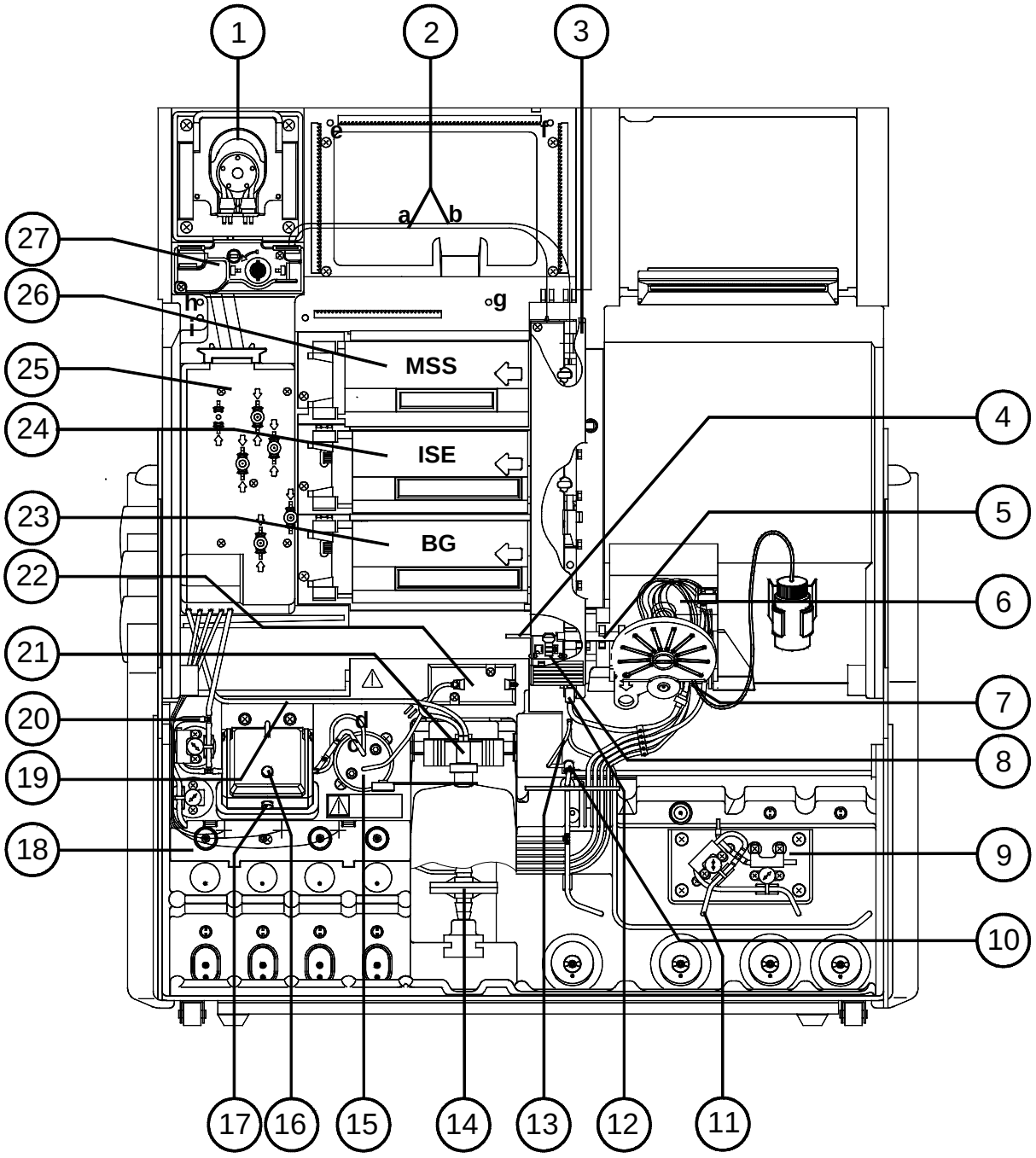


Fig. 86: AVL OMNI™ - front view

①	Peristaltic pump
②	Tubes to sample distributor
③	Sample distributor with SD cartridge and SD cover
④	Tube from sample distributor to tHb cartridge
⑤	T&D sample inlet path
⑥	T&D module
⑦	T&D flap
⑧	Bypass cartridge
⑨	Fluid mixing system (FMS)
⑩	Line for Solution A
⑪	Connection for Solution B
⑫	Second connection of the line for Solution A
⑬	Bottle pipe III to the sample distributor
⑭	Bacteria filter
⑮	Hemolyzer and docking flange
⑯	tHb measuring chamber and securing button or COOX measuring chamber and magnetic clip
⑰	Measuring chamber releasing button
⑱	Tubing cover
⑲	Waste-tube
⑳	T-piece
㉑	Waste cap T2
㉒	tHb cartridge or bottle compartment cartridge
㉓	BG measuring chamber (AVL OMNI™ 1 to 9)
㉔	ISE measuring chamber (AVL OMNI™ 4 to 9)
㉕	Measuring chamber cartridge
㉖	MSS measuring chamber (AVL OMNI™ 7, 8 and 9)
㉗	PP cartridge

AVL OMNI™ - rear view

Screen tiped in forward direction, without vacuum pump and PC tower.

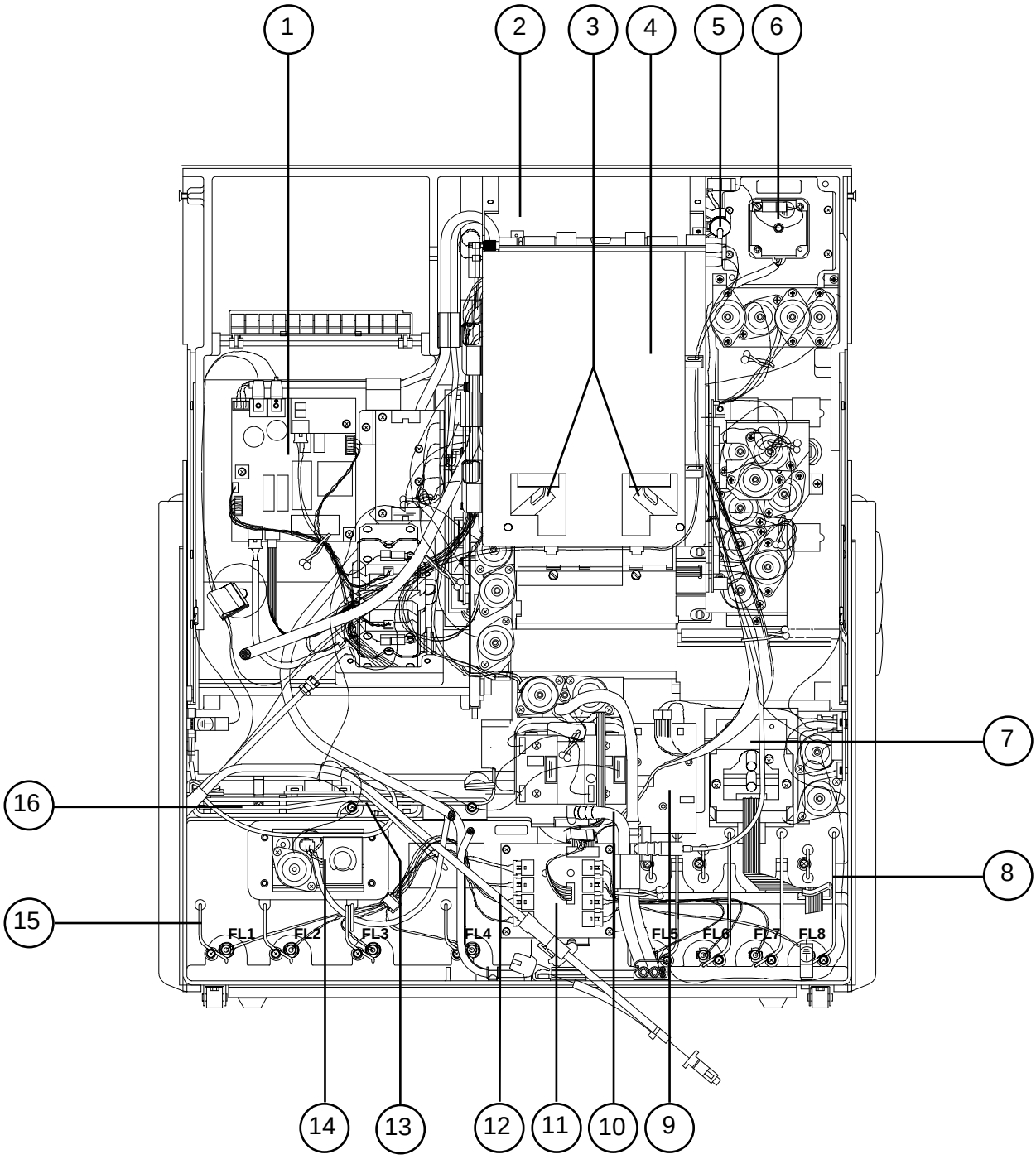


Fig. 87: AVL OMNI™ - rear view

① ..... T&D control
② ..... FLATIF (canceled at devices SN>1500)
③ ..... Ejection flaps
④ ..... Fan and filter
⑤ ..... Vacuum sensor
⑥ ..... Peristaltic pump (PP)
⑦ ..... tHb/COOX module
⑧ ..... Container pipe
⑨ ..... Hemolyzer board
⑩ ..... Connection tubes to vacuum pump
⑪ ..... Fluid level detector board
⑫ ..... AQC cable tree (AutoQC supply)
⑬ ..... Container pipe (Mix line)
⑭ ..... Fluid mixing system (FMS)
⑮ ..... Container pipe
⑯ ..... Buffer line to ventilate Solution B

List of modifications, chapter 6 (System functions)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
General view	•, Δ	Δ	Δ	Δ	Δ		
Test	Δ		Δ	Δ	Δ	Δ	Δ
Setup	•, Δ		Δ	•, Δ	Δ	Δ	•, Δ
Calibration / Util	Δ	Δ	Δ	Δ	Δ	Δ	•, Δ
QC-measurement - Data manager - Options	•, Δ		Δ	•, Δ	Δ	Δ	

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
General view	•						
Test	•						
Setup	Δ						
Calibration / Util	•, Δ						
QC-measurement - Data manager - Options	Δ						

- • Modification (previous states of revision see chapter 10, "Previous revision levels")
- Δ New or addition !

6 SYSTEM FUNCTIONS

General view **6-1**

Test **6-2**

Setup **6-4**

Calibration / Util **6-6**

QC measurement - Data manager - Options **6-8**

6 System functions

This chapter gives an overview of all available system functions of the AVL OMNI™. A description of these functions can be found in the AVL OMNI™ Operator's Manual. The system functions in the service area are secured with a password and are only accessible by service technicians and other authorized persons. These are described in the chapter 8, "Maintenance / Service area".

General view

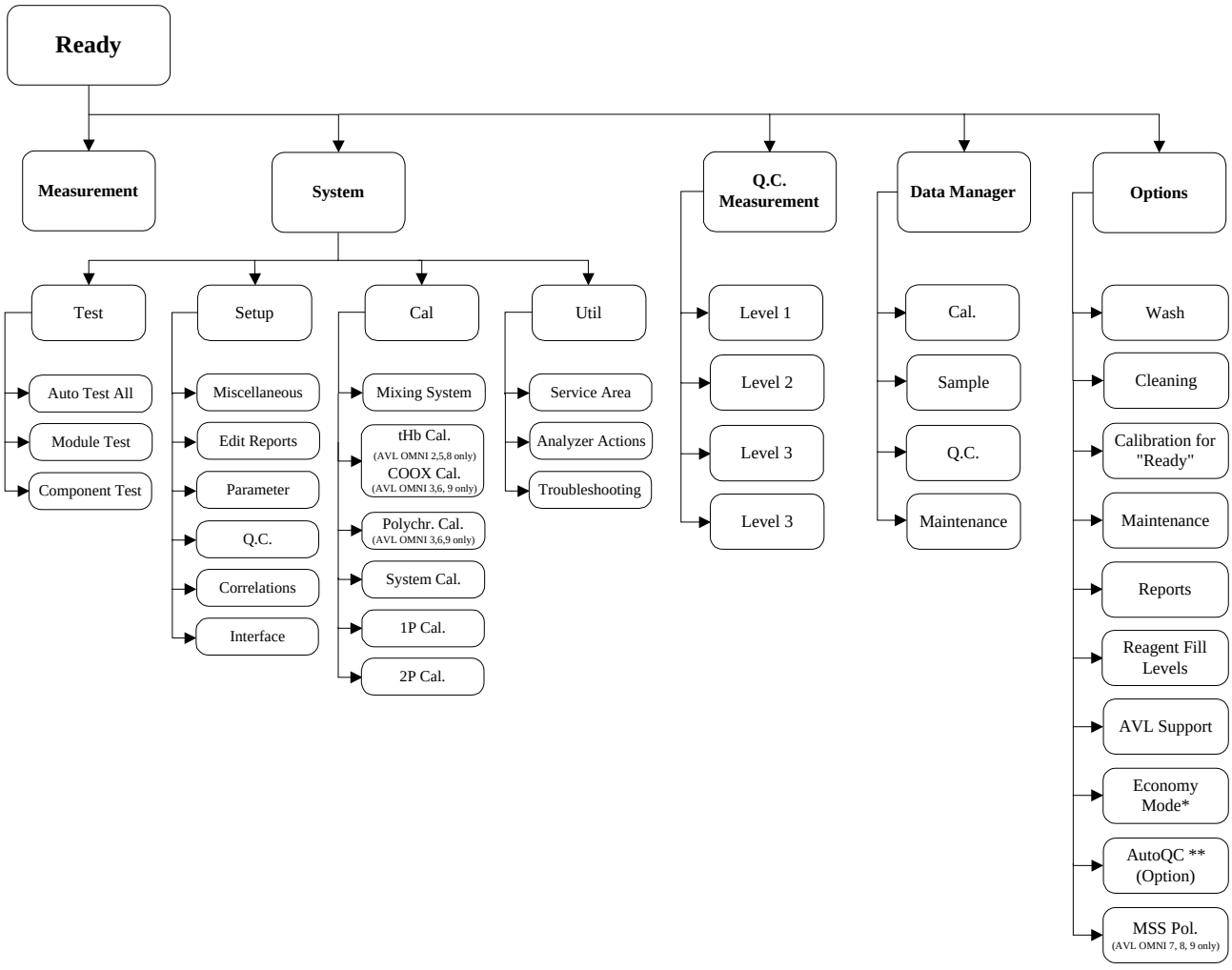
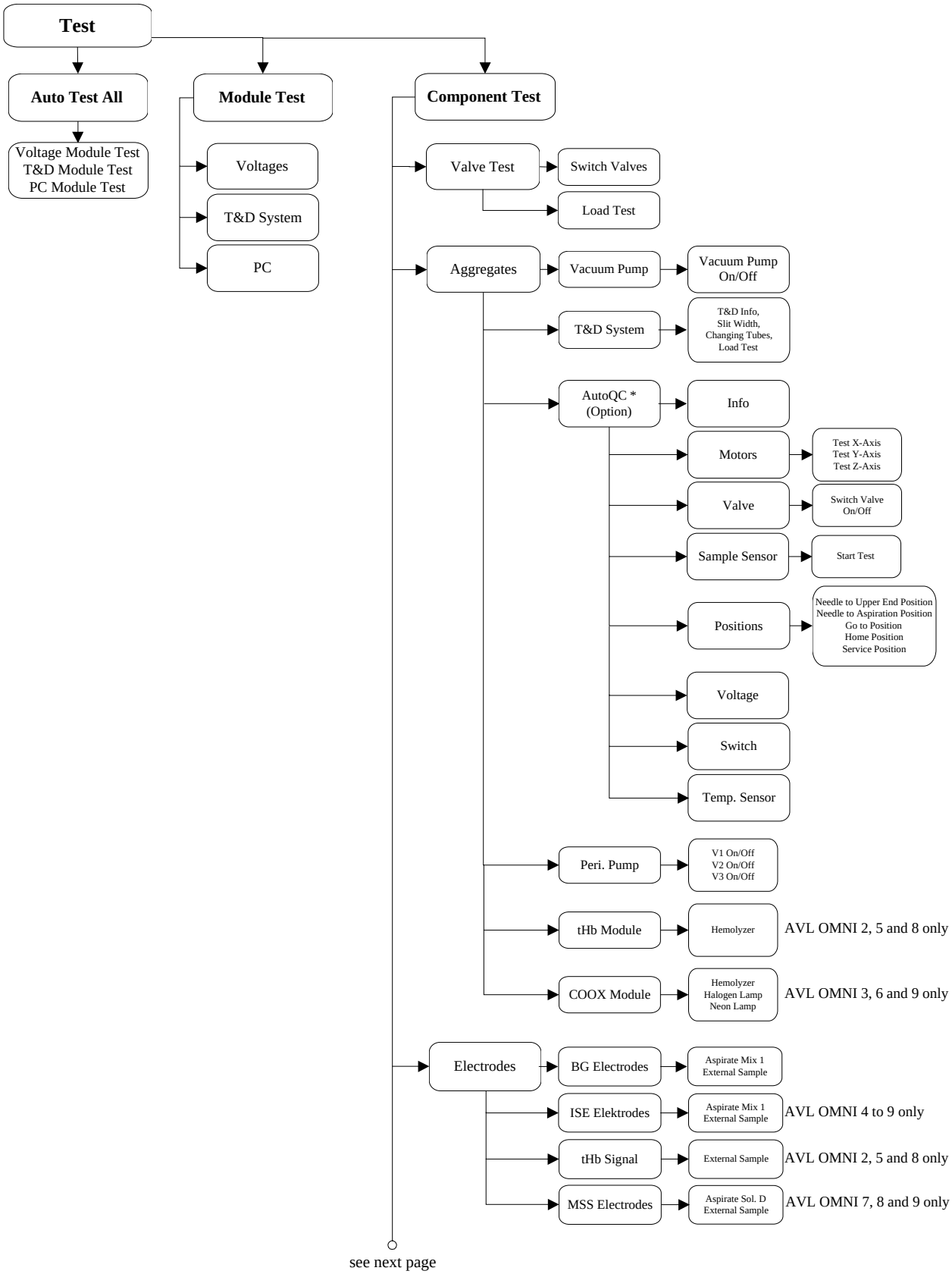


Fig. 1: General view

* This button appears only if activated under "**System - Util -Service Area - Switches 1 - Economy Mode**".

** This button appears only if activated under "**System - Util -Service Area - Switches 1 - AutoQC**".

Test


Test
Auto Test All
Voltage Module Test
T&D Module Test
PC Module Test
Module Test
Voltages
T&D System
PC
Component Test
Valve Test
Switch Valves
Load Test
Aggregates
Vacuum Pump
Vacuum Pump On/Off
T&D System
T&D Info, Slit Width, Changing Tubes, Load Test
AutoQC * (Option)
Info
Motors
Test X-Axis
Test Y-Axis
Test Z-Axis
Valve
Switch Valve On/Off
Sample Sensor
Start Test
Positions
Needle to Upper End Position
Needle to Aspiration Position
Go to Position
Home Position
Service Position
Voltage
Switch
Temp. Sensor
Peri. Pump
V1 On/Off
V2 On/Off
V3 On/Off
tHb Module
Hemolyzer
AVL OMNI 2, 5 and 8 only
COOX Module
Hemolyzer
Halogen Lamp
Neon Lamp
AVL OMNI 3, 6 and 9 only
Electrodes
BG Electrodes
Aspirate Mix 1
External Sample
ISE Elektrodes
Aspirate Mix 1
External Sample
AVL OMNI 4 to 9 only
tHb Signal
External Sample
AVL OMNI 2, 5 and 8 only
MSS Electrodes
Aspirate Sol. D
External Sample
AVL OMNI 7, 8 and 9 only
see next page

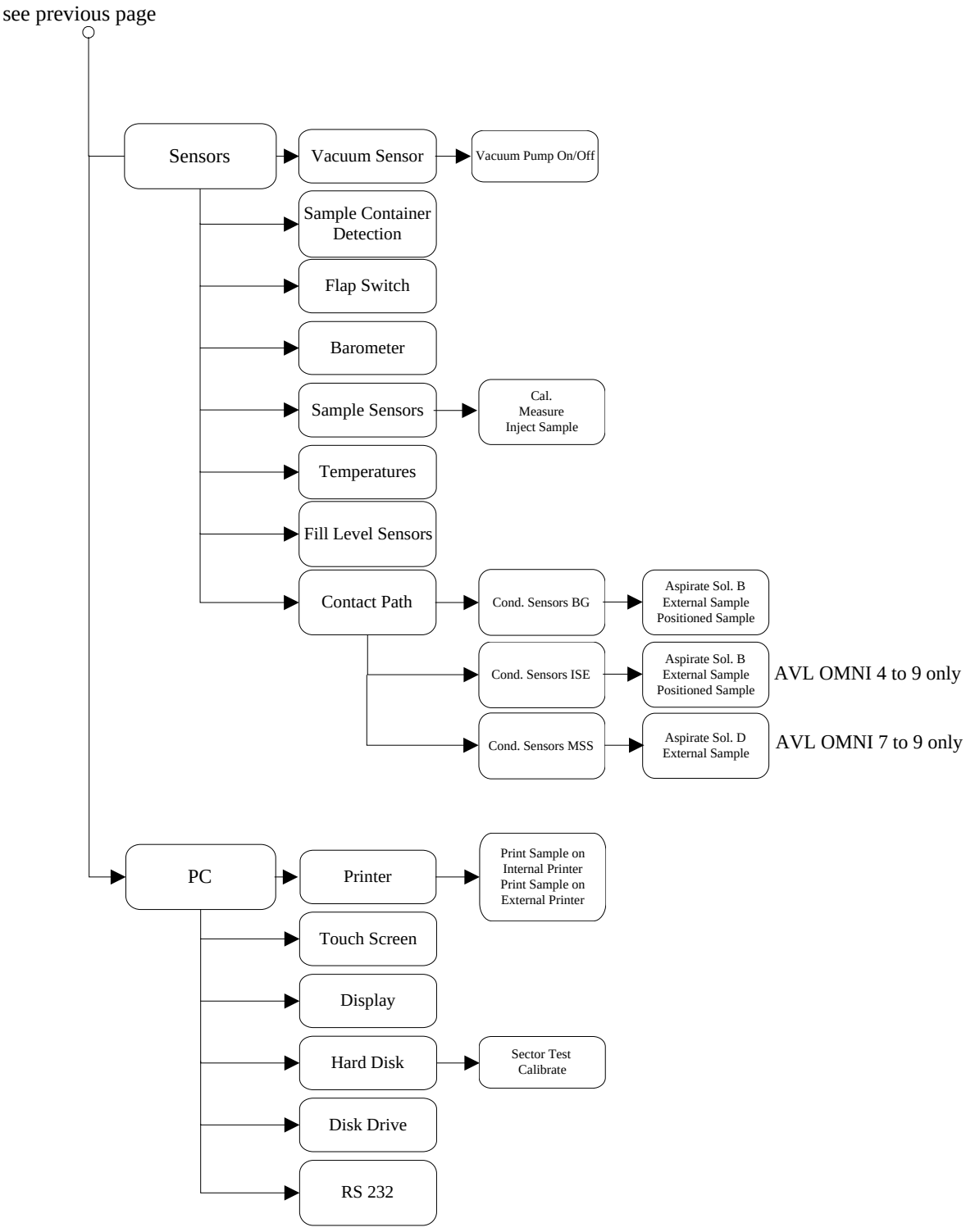
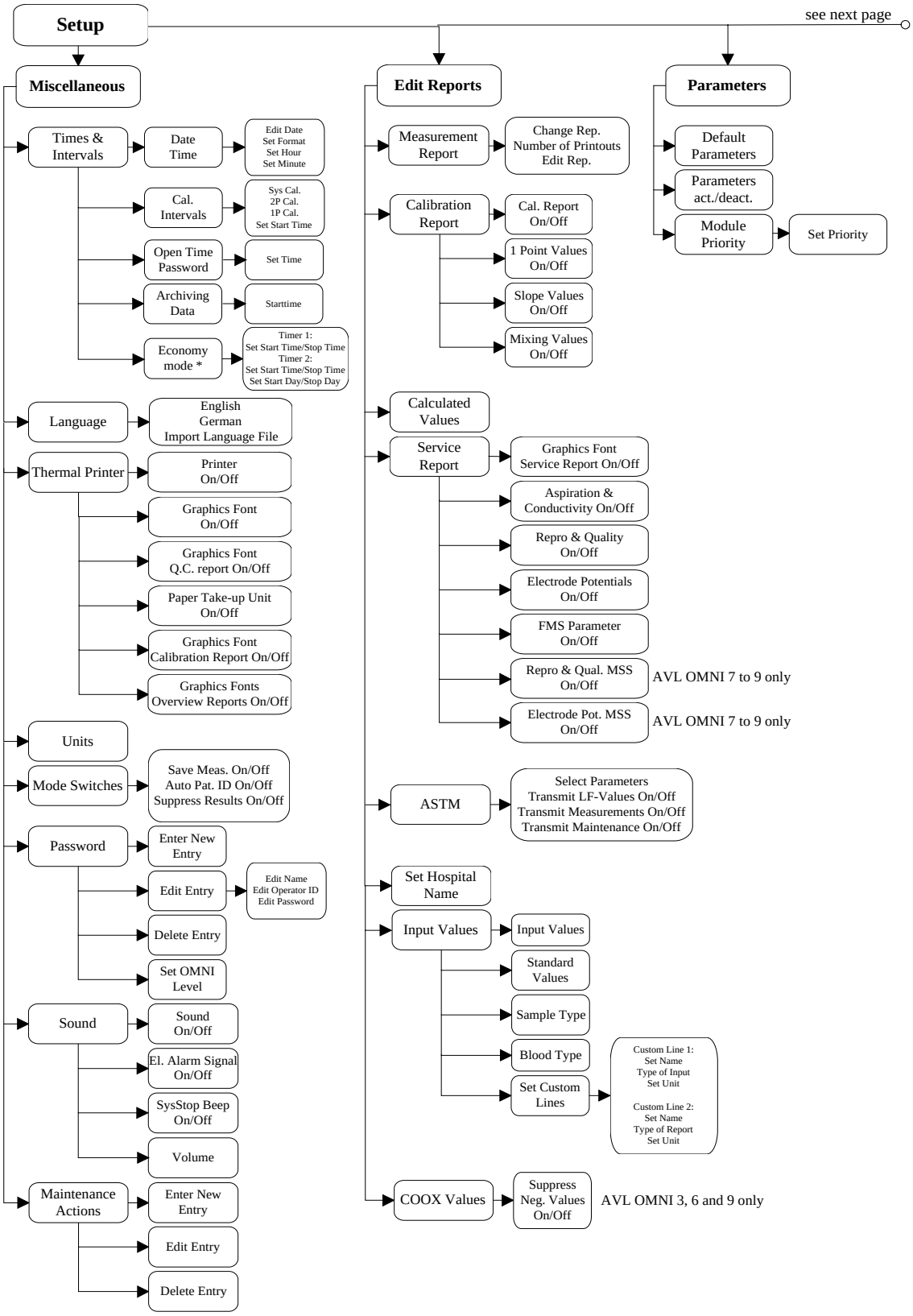
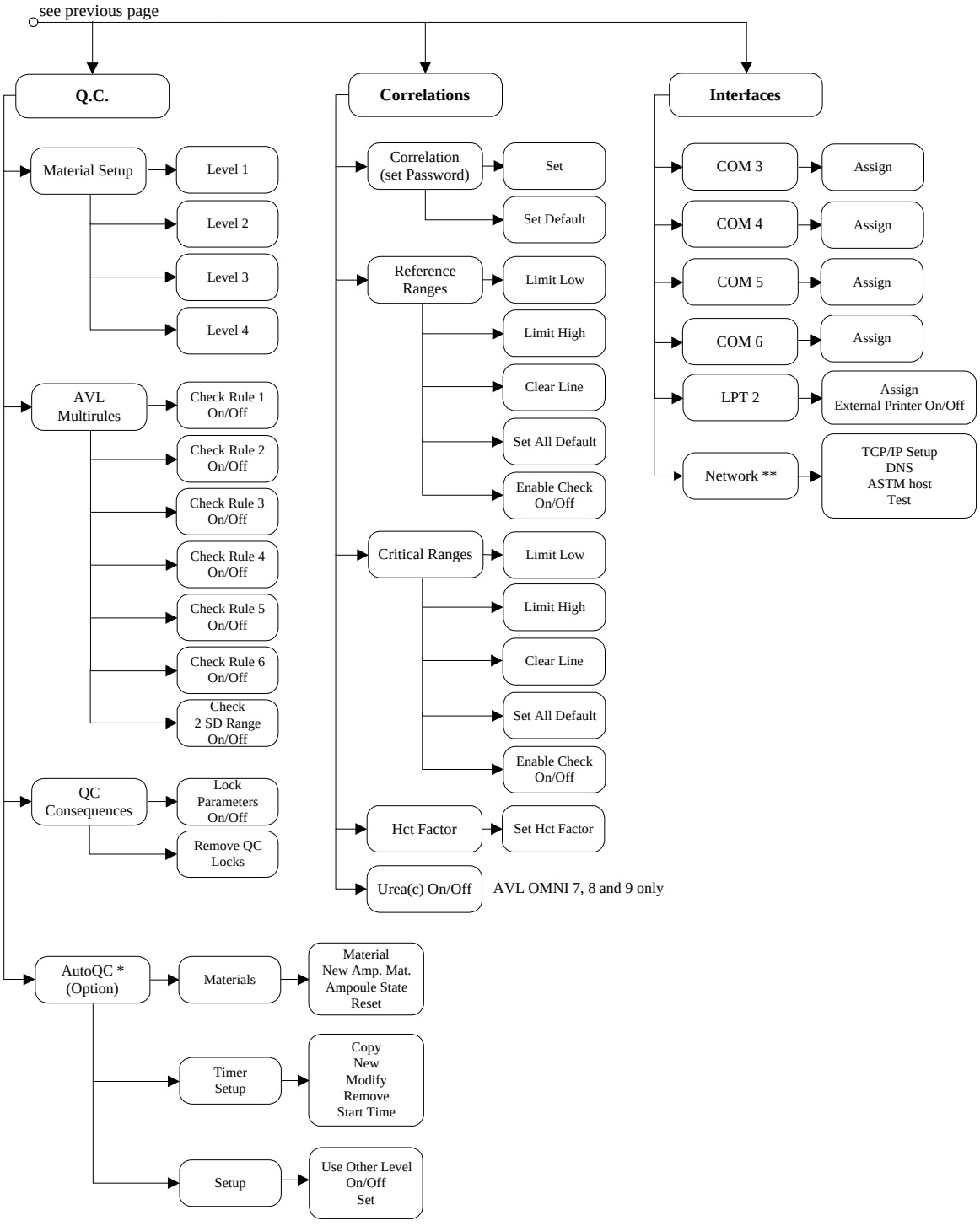

see previous page
Sensors
Vacuum Sensor
Vacuum Pump On/Off
Sample Container Detection
Flap Switch
Barometer
Sample Sensors
Cal.
Measure
Inject Sample
Temperatures
Fill Level Sensors
Contact Path
Cond. Sensors BG
Aspirate Sol. B
External Sample
Positioned Sample
Cond. Sensors ISE
Aspirate Sol. B
External Sample
Positioned Sample
AVL OMNI 4 to 9 only
Cond. Sensors MSS
Aspirate Sol. D
External Sample
AVL OMNI 7 to 9 only
PC
Printer
Print Sample on Internal Printer
Print Sample on External Printer
Touch Screen
Display
Hard Disk
Sector Test
Calibrate
Disk Drive
RS 232

Fig. 2: Test

Setup



* This button appears only if activated under "**System - Util -Service Area – Switches 1 - Economy Mode**".

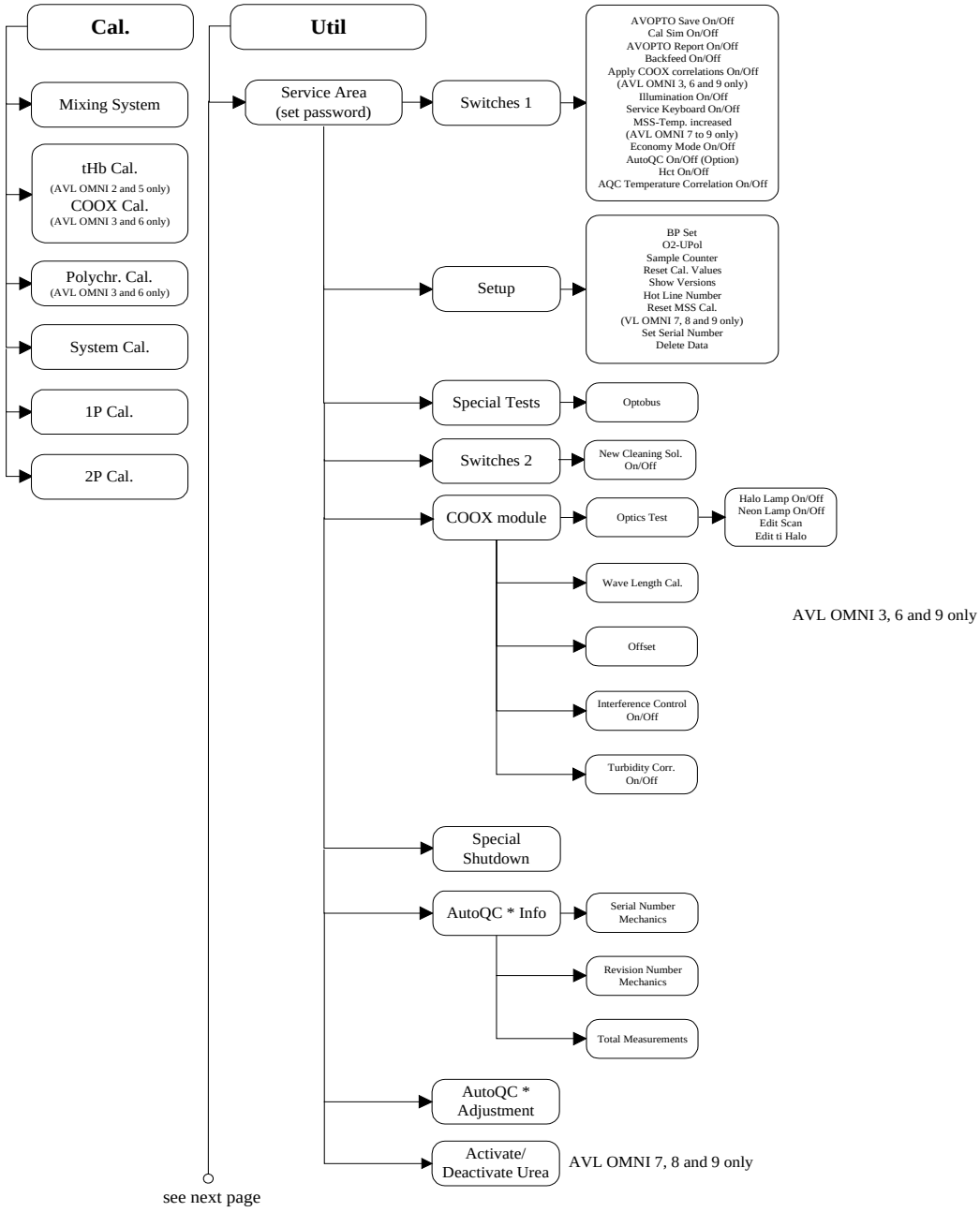


* This button appears only if activated under "**System - Util -Service Area - Switches 1 - AutoQC**".

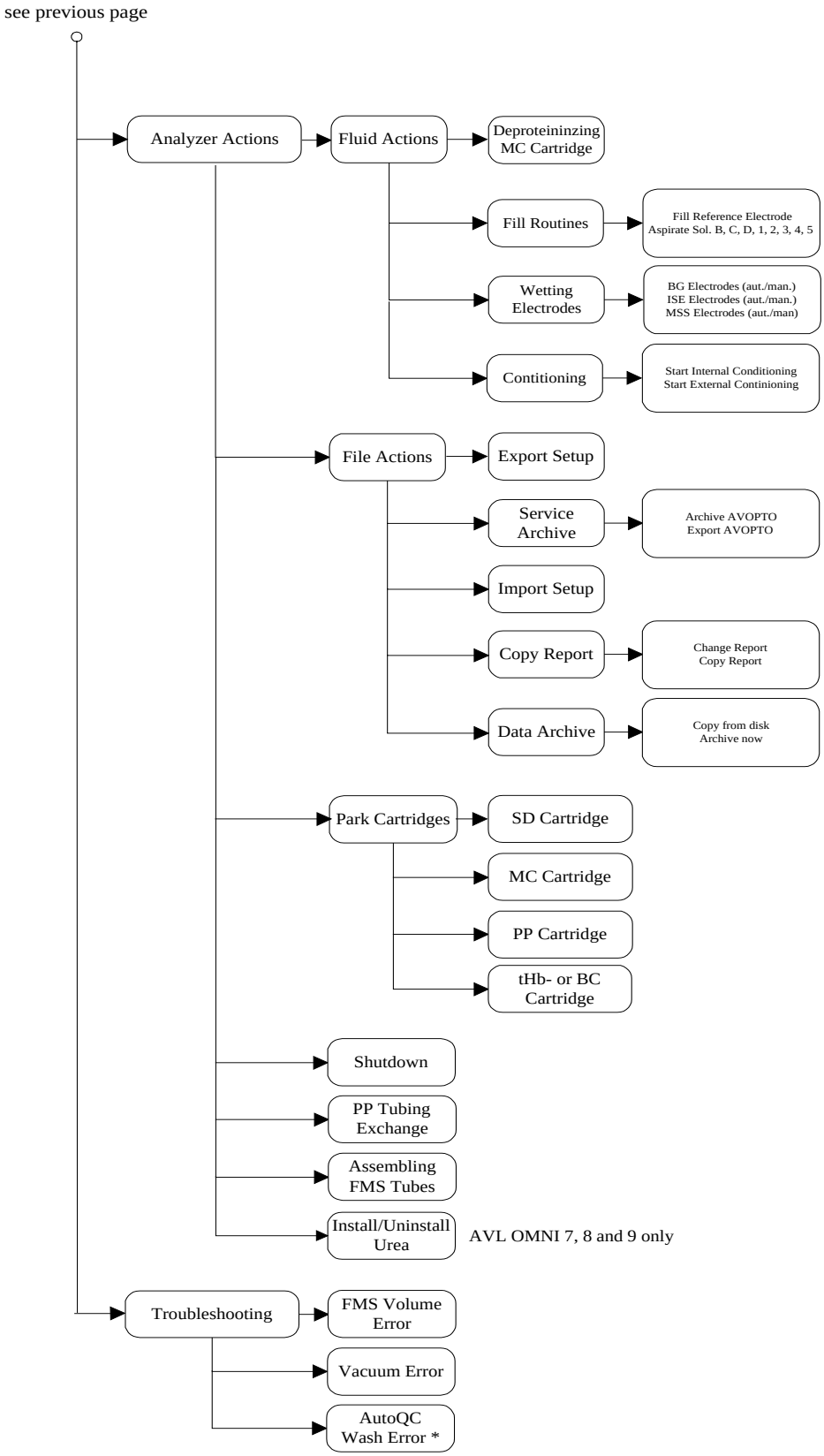
** This button appears only if a network is connected

Fig. 3: Setup

Calibration / Util



* This button appears only if activated under "**System - Util -Service Area - Switches 1 - AutoQC**".



* This button appears only if activated under "**System - Util -Service Area - Switches 1 - AutoQC**".

Fig. 4: Calibration / Util

QC measurement - Data manager - Options

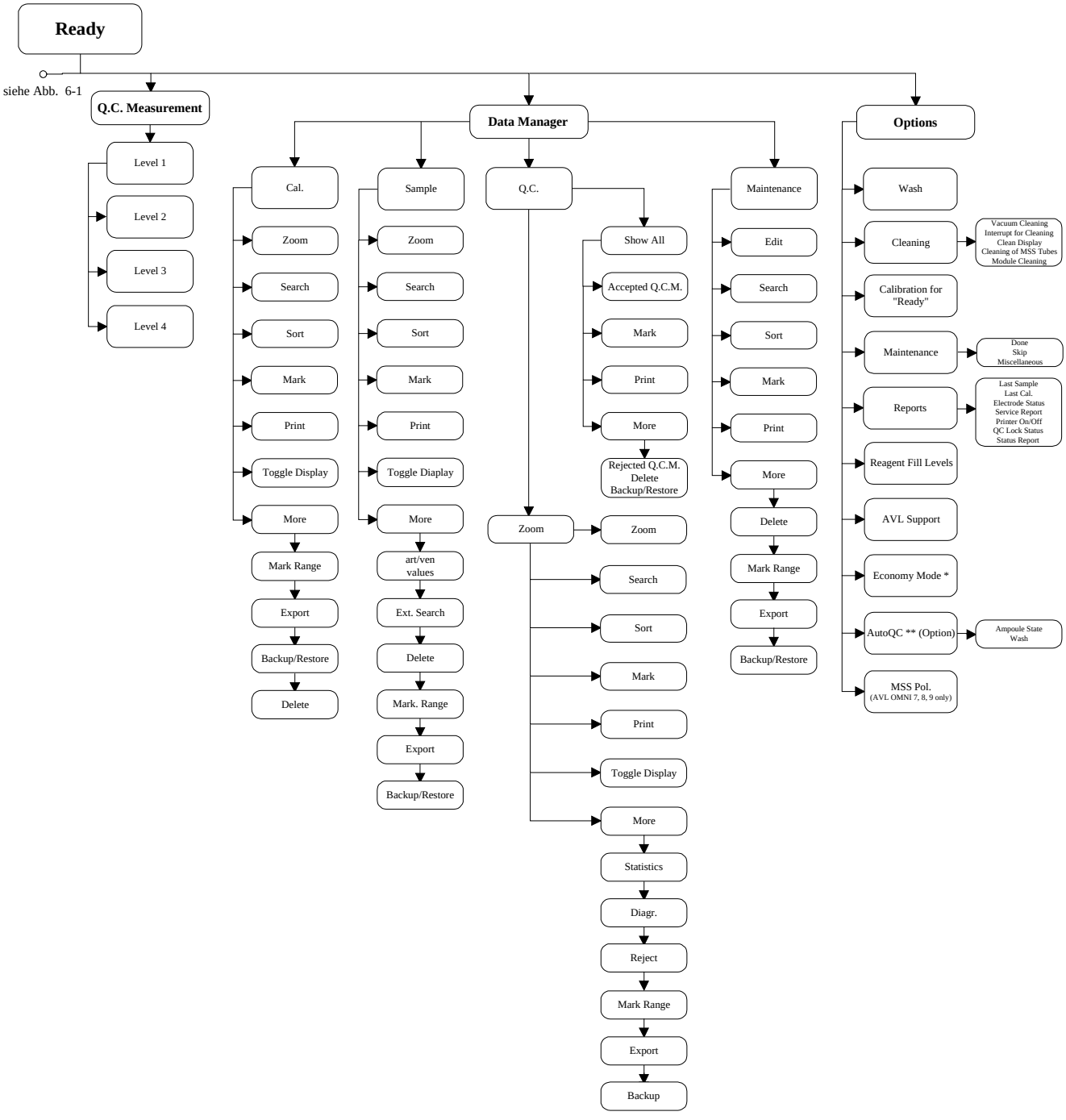


Fig. 5: QC measurement - Data manager - Options

* This button appears only if activated under "**System - Util -Service Area - Switches 1 - Economy Mode**".

** This button appears only if activated under "**System - Util - Service Area - Switches 1 - AutoQC**".

List of modifications, chapter 7 (Functional procedures)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Calibration cycle			Δ		Δ	•	
Measuring cycle			Δ		Δ	•, Δ	•, Δ
MSS polarization						Δ	•, Δ
MSS Ref. calibration (AVL OMNI 7 to 9)					Δ	•, Δ	Δ
MSS Int/1P/Slp calibration (AVL OMNI 7 to 9)					Δ	•, Δ	
Phases of diverse AVL OMNI™ actions			•, Δ				
Aspiration status codes			•				
Tubing diagrams	Δ		•		•, Δ		•, Δ

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Calibration cycle							
Measuring cycle							
MSS polarization							
MSS Ref. calibration (AVL OMNI 7 to 9)							
MSS Int/1P/Slp calibration (AVL OMNI 7 to 9)							
Phases of diverse AVL OMNI™ actions	•						
Aspiration status codes							
Tubing diagrams	Δ						

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

7 FUNCTIONAL PROCEDURES

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Washing the measuring chamber 7-2
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Filling during calibration 7-2
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Mixing of calibration solution 7-4
Stopping the FMS 7-4
Positioning of calibration solution in the reservoir 7-4
Washing the converting line without preparing B/C mixture 7-5
Washing the converting line 7-5
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7 Functional procedures

NOTE: *Symbols such as V2, MCI, VBI, SS1, VBO etc. in this chapter relate to Fig. 1, page 7-27.*

There are two distinct functional main modules in the AVL OMNI™:

- **Calibration cycle**
- **Measurement cycle**
- **MSS Ref. calibration**
- **MSS Int/1P/Slp calibration**

Calibration cycle

This cycle has a modular organization and can be performed in different ways:

- With and without simultaneous tHb- or COOX drying
- With and without preparation of B/C mixture for a further cycle

The calibration cycle is divided in the following phases:

- Starting the tHb- or COOX drying
- Washing and filling the BG measuring chamber
- Washing the converting line (when sample is washed out, otherwise, temporal place holder)
- Washing and filling the ISE measuring chamber (AVL OMNI™ 4 to 9 only), if not: temporal place holder
- Washing the converting line (when sample is washed out) or emptying the converting line and preparing B/C mixture:
  - Start the FMS (fluid mixing system)
  - Mix calibration solution
  - Stop the FMS
  - Position calibration solution in the reservoir

  or without preparing B/C mixture:
  - Follow-up action of FMS
- Emptying of the sample distributor and the air reservoir between sample distributor and PP cartridge

Starting the tHb- or COOX drying

When entering a calibration cycle after a measurement, the dry cycle begins when a tHb- or COOX module is built in.
The drying path from V4 over the tHb- or COOX module, V2 and V23 is switched through. V24 must be closed in this case.

Washing and filling of an AVL OMNI™-BG/ISE measuring chamber

Washing the measuring chamber

(See Fig. 7). During this procedure, the peristaltic pump aspirates with both tubes on the measuring chamber in the clockwise direction (V14 closed). The valves V_I and V_O (VII and VIO for ISE, or VBI and VBO for BG measuring chamber) are opened.
A pump tubing runs over an air reservoir between the PP cartridge und sample distributor exit and leads air from above, back into the sample distributor. Here it is mixed with same parts of FMS mixture for the washing of the measuring chamber.
Time: a few seconds.

Underpressure build-up

In order to enable proper filling of the Junction with the following Reference solution aspiration, an underpressure peak must be created before the actual filling cycle takes place. For this, V21 is closed for split seconds. Simultaneously, V17 is switched over, so that the air supply tube is switched away from the sample distributor, preventing further admixture of air during the following filling procedure.

Filling during calibration

The filling of the measuring chambers begins with the re-opening of the V21. This filling procedure must take place quickly to create underpressure by the time the calibration solution position has been detected. The filling of the measuring chamber is asessed by the conductance measurement. A stable (no moving air bubbles) and a plausible value between MCI and MCO must be measured when solution is in motion. If this does not take place within a time limit, the aspiration status code 1 (see chapter 9, "Aspiration status codes") is given. The liquid column is stopped and positioned by stopping the peristaltic pump (PP) and by closing the valve input (V_I or VII/VBI).
If the conductance measured during motion obviously changes due to the closing of the valve input, it is defined as improper filling of the measuring chamber and leads to the aspiration status code 2 (see chapter 9, "Aspiration status codes").

Aspiration of Reference solution during calibration

(See Fig. 4). At the beginning of this procedure, the measuring chamber valve output (VIO/VBO) is still open and the measuring chamber valve input (VII/VBI) is already closed. Before the Reference solution valve (V9 for ISE or V5 for BG) is opened, the peristaltic pump creates some mbar of under-pressure, to prevent the flow-back of the Reference solution column when the Reference solution valve is opened.
After the Reference solution valve has been opened, the solution is slowly aspirated until the exchange of the rear mixture column against the Reference solution is detected by virtue of a significant increase in conductance between MCI and MCO. No considerable bubble should be aspirated from the Junction during this procedure (leakage!).
If the necessary increase in conductance is not detected within the time limit, aspiration status code 3 (see chapter 9, "Aspiration status codes").
Finally the Reference solution-valve and the valve output (VIO/VBO) are closed. If an obvious change in the conductance occurs, the aspiration status code 4 (see chapter 9, "Aspiration status codes") is given.

Washing the converting line and preparing B/C mixture

(See Fig. 5). During washing and filling of an AVL OMNI™ measuring chamber, the old sample is transferred from the measuring chamber into the converting line. A reservoir which takes up the main part of the sample, is located in the converting line between the measuring chambers and the peristaltic pump. This reservoir is washed out after each measuring chamber wash/filling procedure, to prevent major contamination of the pump, thereby establishing vacuum over V14. The by V3 aspirated Solution A, mixes air to the packaging over V4 (and by assembled tHb- or COOX module V2 V24 T&D) to improve the effectiveness and to minimize the consumption of Solution A.
The pump is briefly turned to the left and to the right during this procedure, to wash out any sample residue from the connecting pieces.
Before an MSS wash/fill procedure, the air reservoir (V15 and V12) is emptied via V21 and V19 with a vacuum.

Starting the FMS

(See Fig. 6). This phase lasts about 3 seconds and serves as the "Carry Over" elimination in the FMS. For this, 2 pre-packages, are mixed which condition the pipe reservoir of the FMS. These pre-packages, wash out an old mixture of the same level or mixtures of another level.
To achieve air bubble division V19 is positioned and the mixer valve is stopped (Solution B is pinched off).

Mixing of calibration solution

(See Fig. 6). During the actual mixing procedure a pump tube over V17 aspirates on the FMS. The mixing valve switches at the proper time, between Solution B and Solution C. V19 clamps off the air flow and releases Solution C at the same time.

Stopping the FMS

(See Fig. 6). Here, the mixing procedure is stopped exactly after the mixing valve cycle is completed and the mixture column is absorbed by the cross piece.
It causes the separation of B-column from C-column.

Positioning of calibration solution in the reservoir

(See Fig. 6). The fluid mixing must be in a defined position to the FMS-air bubble trap at the beginning of the measuring chamber wash/filling procedure. In order to compensate the tolerances of the FMS-reservoir and the pump conveying capacity, a positioning time is determined at each mixing system calibration. At each calibration, the mixture will be aspirated according to the pre-determined time and positioned in this manner.

Washing the converting line without preparing B/C mixture

Washing the converting line

Description see page 7-4.

Follow-up of the FMS

(See Fig. 7). In order to determine if the Junction cannot be completely filled for measurement series, the FMS is emptied with the peristaltic pump over V17, when no further calibration cycle is necessary.

Emptying the converting line

(See Fig. 5). If the converting line has not been washed, it will be emptied between the modules to separate the conductive connection between the modules.

Empty sample distributor and air-reservoir (sample distributor-PP cartridge)

The sample distributor and the reservoir must be empty between the sample distributor outlet above and the PP cartridge, in the standby condition.
This air-reservoir is needed for the washing of the measuring chambers, during calibration.
The final step in a calibration- or measuring cycle is the exact emptying of the tubing unit which has been mentioned. As long as the end of the liquid column is located between VBI and VSI, aspiration takes place slowly. The pump speed is drastically increased resulting in the emptying of the entire reservoir, after the end of the column has passed VSI.

Preparing Rinse packages in the converting line

Approx. 50 µl Rinse fluid are aspirated into the converting line between V4 and VBO.
This segment of rinse fluid will be needed for rinsing the converting line in the subsequent cycles.

Measuring cycle

The following description applies to the following module priority:
BG - tHb - ISE - MSS.

- Sample input
- Sample distribution:
  - Positioning at sample sensor SS2
  - Positioning in the sample distributor (SS1)
  - Positioning a sample segment for the tHb- or COOX measurement (when requested) and filling the converting with Solution A
- Aspiration of the sample in the BG measuring chamber (when requested)
- Aspiration of the sample in the ISE measuring chamber (AVL OMNI™ 4, 5 and 6 only), when requested
- Aspiration of the sample in the MSS measuring chamber (AVL OMNI™ 7, 8 and 9 only), when requested
- Remove sample excess into the sample distributor (without MSS only)
- Aspiration of the sample in the tHb- or COOX measuring chamber
- Washing and filling the MSS measuring chamber with Solution D
- Start the FMS and wash the measuring chamber environment
- Wash tHb or COOX and mix FMS solutions
- Dry sample inlet path/sample distributor and mix FMS solutions
- Empty tHb- or COOX module
- Calibration cycle

Sample input

After detecting a sample container on the T&D, the AVL OMNI™ either waits for a signal from SS2 (AVL OMNI ™ 5 and 6 only) or the pressing of the "**Aspirate Sample**" -key.

- The injected sample is introduced into the sample inlet path by closed V22, over SS2, V24, SS3 and V23 into the Waste.
- The aspirated sample is introduced into the sample inlet path by closed V23 over SS2, V22, QK, V15, and V17 with the peristaltic pump.

When the sample reaches the required SS position for the specific serial model modification**,** an acoustic signal is given and the removal of the sample container is requested via display.

Required SS position:

AVL OMNI™ 1	SS4 (T&D/right)
AVL OMNI™ 2, 3	SS4 (T&D/left)
AVL OMNI™ 4	SS4 (T&D/center)
AVL OMNI™ 5, 6	SS2
AVL OMNI™ 7, 8, 9	SS6 (T&D/center)

The AVL OMNI™ identifies the removal of the sample container by the container detector. As soon as the light gate is free, the AVL OMNI™ takes over sample control for syringe measurements as well.

Sample distribution

(see Fig. 10, Fig. 11 and Fig. 12)

Sequence of individual aspiration phases with different module priorities

BG/tHb/ISE	1. separation of BG 2. separation of tHb/COOX 3. positioning of BG + separation of ISE 5. positioning of ISE 6. removal of excess sample 6. positioning of tHb/COOX	**BG/ISE/tHb**	1. separation of BG 2. positioning of BG + separation of ISE 3. separation of tHb/COOX 4. positioning of ISE 5. removal of excess sample 6. positioning of tHb/COOX
BG/ISE	1. separation of BG 2. positioning of BG + separation of ISE 3. positioning of ISE 4. removal of excess sample	**BG/tHb**	1. separation of BG 2. separation of tHb/COOX 3. positioning of BG 4. removal of excess sample 5. positioning of tHb/COOX
tHb/ISE	1. separation of tHb/COOX 2. separation of ISE 3. positioning of ISE 4. removal of excess sample 5. positioning of tHb/COOX	**ISE/tHb**	1. separation of ISE 2. separation of tHb/COOX 3. positioning of ISE 4. removal of excess sample 5. positioning of tHb/COOX
BG/tHb/ISE/MSS	1. separation of BG 2. separation of tHb/COOX 3. positioning of BG + separation of ISE 4. positioning of ISE 5. separation of MSS 6. positioning of MSS 7. positioning of tHb/COOX	**BG/ISE/tHb/MSS**	1. separation of BG 2. positioning of BG + separation of ISE 3. separation of tHb/COOX 4. positioning of ISE 5. separation of MSS 6. positioning of MSS 7. positioning of tHb/COOX
BG/ISE/MSS	1. separation of BG 2. positioning of BG + separation of ISE 3. positioning of ISE 4. separation of MSS 5. positioning of MSS	**tHb/ISE/MSS**	1. separation of tHb/COOX 2. separation of ISE 3. positioning of ISE 4. separation of MSS 5. positioning of MSS 6. positioning of tHb/COOX
BG/tHb/MSS	1. separation of BG 2. separation of tHb/COOX 3. positioning of BG 4. separation of MSS 5. positioning of MSS 6. positioning of tHb/COOX	**tHb/MSS**	1. separation of tHb/COOX 2. separation of MSS 3. positioning of MSS 4. positioning of tHb/COOX
ISE/tHb/MSS	1. separation of ISE 2. separation of tHb/COOX 3. positioning of ISE 4. separation of MSS 5. positioning of MSS 6. positioning of tHb/COOX		

Positioning at SS2

To achieve the sample volume limit, the input positioning takes place at the Sample inlet path sample sensors, in the AVL OMNI™ versions < AVL OMNI™ 5. For the synchronization of this procedure, the sample must be aspirated to the general distribution start point SS2 (when necessary).

Positioning in the sample distributor (SS1) - separate BG

In this case, the same path through which a capillary is aspirated, is used.

Positioning of a sample segment for the tHb- or COOX - measurement and filling the converting line with Solution A

Here, aspiration takes place over the converting line (closed V14), V4, V2, SS3 and V24 (closed V23). If it is not possible to position the sample column from SS3 reaching back to SS2, the tHb- or COOX aspiration error 11 (see chapter 9, "Aspiration status codes during measurement") is given.
To ensure proper sample transportation, particularly for the Hb aspiration cycle, 2 large segments of Solution A are subsequently aspirated into the converting line via V3.

Aspiration of the sample in the BG measuring chamber - positioning BG

(See Fig. 4). This aspiration procedure requires that the sample contact peak is located at SS1. It is aspirated with the peristaltic pump over VBI, VBO and the converting line.
The start of movement is detected by the breaking off of the calibration liquid peak in the measuring chamber (conductance).
If this situation is not reached in time, a BG aspiration error 2 (see chapter 9, "Aspiration status codes during measurement") is given.
If a time-out is exceeded or no sample is detected at SS1 for more than 1.2 seconds, a BG aspiration error 1 (see chapter 9, "Aspiration status codes during measurement") is given.
During the aspiration process, the sample is monitored via sample sensor SS1. An insufficient sample volume is stopped and aspiration prevented.
After VB1 closes, the conductivity ratio between MCI-MCO to MCI-MCC is checked. Air bubbles in the area of the MCI-MCO may reestablish the aspiration process (VBI is reopened).
The sample positioning process itself is completed with the conductivity ratio determination.
In order to achieve a defined sample Reference solution combination, the following must be done (see Fig. 13):

- In order to minimize the blood contamination during further function, "evacuate" the Junction by briefly opening V7 at the beginning.
- Allow a "portion" of Reference solution to flow in (open V5 and close again).
- Establish a bridge by pushing back and check with MCI-MCO.

If the established bridge cannot be verified, a BG aspiration error 3 (see chapter 9, "Aspiration status codes during measurement") is given.
Finally, the VBO is closed and the conductance is checked once again. If the value has changed significantly, the BG aspiration error 4 (see chapter 9, "Aspiration status codes during measurement") is given.

Aspiration of the sample in the ISE measuring chamber (AVL OMNI 4 - 9)

This aspiration process requires the sample column peak to be located at SS1 or VBI and proceeds nearly in the same manner, as the aspiration into the BG measuring chamber.
If no ISE measurement was selected, the remaining sample is positioned around VII through the sample distributor to establish the identical starting status for the subsequent MSS filling.

Aspiration of the sample in the MSS measuring chamber (AVL OMNI 7, 8 and 9 only)

(See Fig. 10 and Fig. 11). This aspiration process starts with the sample column tip being positioned at VII. Before the actual aspiration process starts, the sample is positioned at sample sensor SS4 to minimize air bubble formation (in case of error, aspiration is halted and an aspiration error 20 is displayed (see chapter 9, "Aspiration status codes during measurement"). Thereafter, the aspiration process is identical to that for BG, but without Ref. aspiration actions.

Removal of excess sample into the sample distributor

Here, excess sample material will be aspirated from the sample distributor to ensure constant tHb- or COOX sample volumes.
This routine is performed only in devices without or with deactivated MSS module.
If sample sensor SS2 detects a sample before COOX/tHb positioning, a sample distribution error occurs.

Apiration of the sample in the tHb- or COOX measuring chamber

This is only performed when a tHb- or COOX measurement is requested and the tHb- or COOX sample segment can be positioned properly.
The tHb- or COOX sample is aspirated quickly to, and slowly through the hemolyzer. In order to remove foam from the hemolyzed sample, it remains in the air bubble trap for a short time and is then positioned in the cuvette.
Aspiration takes place over the converting line, V4, cuvette, air bubble trap, hemolyzer and V2.
It is important that excessive sample fluid is properly removed from the sample distributor.

Washing and filling the MSS measuring chamber with Sol. D

The remaining sample is moved out of the sample distributor towards the peristaltic pump by vaccum.
After completion of the BG- and MSS signal detection, Solution D is aspirated in the MSS measuring chamber through the unwashed sample distributor. The procedure is identical to the “Washing and filling the MSS measuring chamber with Solution D” routine, Section “MSS Ref. calibration“, page 7-19.
Calculation of the measured value can begin only after detection of the reference value, which means that problems occurring during positioning and calculation of the reference value will be included in the measurement and identified as flag 14 (Ref. n. ok).
That means that the results will be displayed after the reference point calibration.

Starting the FMS and washing the measuring chamber surroundings

(See Fig. 5). This procedure is identical to the starting of the FMS during a calibration cycle. The only difference is, that the measuring chamber surroundings are washed simultaneously during a measuring cycle.
First, sample inlet path and bypass are washed for approx. 1.5 seconds with vacuum over the T&D Pos.2 and emptied into the Waste. Thereafter, the path over the sample distributor, V15 and V16, are switched on. After both paths have been briefly washed (approx. 0.5 seconds) V23 is closed. The washing of the sample distributor is stopped after 2 more seconds. The T&D still remains docked-on.

The FMS is started simultaneously. Same procedure as during calibration.

tHb- or COOX washing and mixing of the FMS solution

(See Fig. 6). The tHb- or COOX module is washed over V3, V4, cuvette, air bubble trap, hemolyzer, V2 and V23 into the Waste (V24 is closed), in the opposite direction in which the sample is aspirated. At this point, washing is done with 2 Solution A-packages, rinsing with one larger Solution A-package and the filling for the reference measurement is performed.The introduction of air takes place over V4.

The mixture of the FMS solution is performed simultaneously to this procedure or to its place holder.

Drying of the sample inlet path/ sample distributor and mixing the FMS solution

The sample inlet path and sample distributor is dried with vacuum over V24, V23 and over sample distributor, V15, V16.
The FMS solution is mixed simultaneously. The FMS is stopped earlier and re-aspirated when only one measuring chamber is used for measurement. Otherwise, the FMS is stopped after this phase has been completed.

Empty tHb- or COOX module

Before the actual drying of the tHb- or COOX module against the aspiration direction begins, the module is emptied into the Waste over the converting line (approx. 1 second).

MSS polarization

General information

The MSS polarization procedure is performed after a new MSS cassette is installed in the AVL OMNI™.

NOTE: *The whole blood required for the MSS polarization should not be older than 24 hours,*
contain heparin as an anticoagulant and
have a volume of min. 150 µl.

Other blood samples would not moisten the MSS sensor and cause a termination of the polarization routine and possibly sensor failure.

Make sure sufficient volumes of Solutions 3 and D are available and that the Waste container has the capacity to collect these fluids.

MSS polarization procedure

MSS cassette exchange

After the MSS cassette has been replaced in accordance with the procedure described in the AVL OMNI™ Operator's Manual, introduce the sample. The sample can be introduced using a syringe or capillary.
After removing the sample container with sample at SS2, the sample is positioned at the measuring chamber input (SS4). SS1 monitors sample aspiration into the sample distributor and a sample column that is too short or inhomogenous ("no sample") would cause a termination of the polarization procedure.
During the wash routine, the message window first displays the sample positioning error and then the termination of the polarization ("MSS polarization not ok"). Flag 37 "No sample (Pol)" is printed on the service report and "MSS polarization not ok 5" is displayed. In the calibration data base, the display "Wait for cal." indicates that no MSS calibration was performed
(see also chapter "Troubleshooting" under "Service report - MSS status").
It is necessary to call up the polarization procedure again.

Filling the measuring chamber

After the sample having been positioned at SS4, the sample is aspirated into the measuring chamber. After the calibration solution from the cooling block has filled the sensor, the air bubble and sample follow. The sample is aspirated very slowly into the MSS cassette. Sample aspiration is monitored by SS4 (8s timeout).

Polarization

After the sample path has been washed, the sensor has 3 minutes to become active, i.e. the sensor signal drift drops below 10% and noise interference decreases so that signal evaluation is possible.
The screen shows "**Polarization running**" procedure.

First evaluation

With the aid of Solution 3 (high calibration level) and D (reference value), a first evaluation of the sensor is performed. During each cycle, Solution 3 is aspirated and Solution D is aspirated twice for the calculation of the slope. Based on five slopes, the mean of the last 3 cycles is used for the evaluation. The service report shows the aspiration status (report 1) and the potentials of the C2/D cycles (report 6) under “Pol Chk“.

The assay ranges are:

BSA	**-1000**	**to**	**1000 mV**
LAC	**50**	**to**	**2000 mV**
GLU	**30**	**to**	**2000 mV**
NH4	**15**	**to**	**75 mV**
K	**35**	**to**	**75 mV**
Urea	**150**	**to**	**340 mV**

The screen continues to display the progress of the polarization procedure.
If the limits for BSA, GLU, LAC or Urea are not reached, alarm codes are issued and the message window shows the following error messages:
00200000 „Urea is defective“
00400000 „Glu is defective“
00800000 „Lac is defective“
This warning can be eliminated by a successful calibration or by installing a new MSS cassette.
If aspiration errors occur during evaluation (6x “no sample“), the polarization procedure is terminated, i.e. alarm code 00100000 is issued “MSS polarization not ok“ and the messages are displayed as under “MSS cassette exchange“ but with “MSS polarization not ok 6“.

Termination of filling procedure, polarization or first evaluation

If during these phases a manual termination, an alarm or a system stop occur, such as

- Solution 3, R3 or D is empty
  (“Check MSS Solutions“ in message window),
- Waste is full (system stop),
- temperature alarm,
- measuring chamber cover was openend,

the polarization is terminated, the alarm code 00100000 is set and the message “MSS polarisation not ok“ is displayed.
The electrode status for BSA, LAC, GLU, NH4, K and Urea is “Pol. cancelled“ and the service report shows flag 39.
The calibration database continues to show that the MS sensor is waiting for calibration.

Example of an **Aspiration and Conductivity** report after termination:

AVL OMNI
Service Report
Aspiration & Conductivity

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

<!> Empty Ref
<E> 10:32 SSE-Cover Error

Pol Chk 29.05.1998 10:32

	Aspiration Status				Conductivity			Aspiration Temp		
	BG	ISE	MSS	tHB	BG	ISE	MSS	BG	ISE	MSS
<E>				10:32 Zero Solution						
<E>				10:32 Fill Levels						
<E>				10:36 MSS Polarization Running						
C2	-	-	0	-	-	-	-	-	-	-
D	-	-	0	-	-	-	-	-	-	-
C2	-	-	0	-	-	-	-	-	-	-
D	-	-	0	-	-	-	-	-	-	-
C2	-	-	0	-	-	-	-	-	-	-
D	-	-	0	-	-	-	-	-	-	-
C2	-	-	0	-	-	-	-	-	-	-
D	-	-	0	-	-	-	-	-	-	-
C2	-	-	0	-	-	-	-	-	-	-
D	-	-	0	-	-	-	-	-	-	-

Stby 10:43 FMS: 0.50

Wash 29.05.1998 10:43

	Aspiration Status				Conductivity			Aspiration Temp		
	BG	ISE	MSS	tHB	BG	ISE	MSS	BG	ISE	MSS
<E>				10:44 Zero Solution						
<E>				10:44 Fill Levels						
<E>				10:44 MSS Polarization Running						

Stby 10:45 FMS: 0.50

<!> Empty Ref
<!> MSS SOL D : 36.28 46.27 47.49 1328.11 642.14 571.49

Example of an **Electrode Pot. MSS** report after termination:

AVL OMNI
Service Report
Electrode Potentials MSS

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

<!> Empty Ref

Pol Chk 29.05.1998 10:32

	Potential						Standard Deviation					
	BS	LA	GL	NH	K	UR	BS	LA	GL	NH	K	UR
<E>					10:32 Zero Solution							
<E>					10:32 Fill Levels							
<E>					10:36 MSS Polarization Running							
C2	22	807	834	42	53	241	-	-	-	-	-	-
D	20	124	88	1305	618	553	-	-	-	-	-	-
C2	6	780	815	37	49	234	-	-	-	-	-	-
D	35	141	90	1324	637	567	-	-	-	-	-	-
C2	9	774	813	40	52	236	-	-	-	-	-	-
D	36	143	95	1334	648	578	-	-	-	-	-	-
C2	8	770	816	40	50	236	-	-	-	-	-	-
D	34	144	97	1343	656	586	-	-	-	-	-	-
C2	7	761	816	39	49	236	-	-	-	-	-	-
D	34	145	100	1350	663	594	-	-	-	-	-	-
Stby		10:43			FMS: 0.50			MSS-Counter: 620				

Wash 29.05.1998 10:43

	Potential						Standard Deviation					
	BS	LA	GL	NH	K	UR	BS	LA	GL	NH	K	UR
<E>					10:32 Zero Solution							
<E>					10:32 Fill Levels							
<E>					10:36 MSS Polarization Running							
Stby		10:45			FMS: 0.50			MSS-Counter: 714				

<!> Empty Ref
<!> MSS SOL D : 36.28 46.27 47.49 1328.11 642.14 571.49

Wash cycle

Regardless of whether the polarization was terminated or properly completed, a wash cycle of the sample path follows, then all sensors will be recalibrated and the system will return to the Ready mode. If the polarization procedure was completed properly, the system will return to Ready mode after approx. 8 minutes, if polarization was terminated with the message “MSS polarisation not ok“, Ready status is reached sooner.

One hour without MSS Ready

BG, ISE and tHb/COOX are now ready for measurement again and the calibrations required for these parameters are being performed. Calibrations for MSS cannot be activated.
This phase is indicated in the message window and the electrode status report as “Pol. is on“, the service report shows a status flag 38 for Glu, Lac, BSA, NH4, K and Urea and the data manager shows “Wait for cal.“.
During this time, the MSS sensor is flushed with solution D.

Flushing with Sol. D (“MSS SOL_D“)

This procedure is similar to “Flush Ref.“ and “Empty Ref.“ (see also chapter “Troubleshooting, section “Service report/Report structure“), it runs in the background and can be terminated at any time.
This routine flushes the sensor to prevent enzyme migration.
Intervals depend on sensor usage (beginning with reading the MSS cassette barcode) and are as follows:

GLU/LAC:
0 - 2h: every 5 minutes
2 - 24h: every 15 minutes
24 - ∞h: every 60 minutes

GLU/LAC/UREA:
0 - 2h: every 5 minutes
2 - ∞h: every 10 minutes

The interval counter will be restarted with every MSS SOL_D cycle or calibration cycle with Solution D.

Procedure and signal evaluation

After the sample distributor has been emptied via FMS (V21), Solution D is prepared in the upper sample distributor area, pushed back to SS4 (ventilation again via FMS V21) and approx. 40 µl are aspirated in the measuring chamber. If SS4 detects nothing, no aspiration in the measuring chamber will occur. A “no sample“ evalution is currently not available. The sample distributor channel is emptied again.
After positioning in the measuring chamber is completed, the sensor signals are detected and evaluated.
These sensor signals can be seen on the service report (sequence BSA, LAC, GLU, NH4, K, UREA).
If the reference potentials (C2 signal for urea) of all MSS sensors are within one window,
3 <BSA <200,
3 <LAC <250,
3 <GLU <200,
Urea >200 (first evaluation),
an 2P MSS calibration can be activated early, i.e. electrodes status flag 38 is replaced with flag 8 and the first calibration is started.
In 99% of the cases, it will take 50 minutes before the first calibration starts.

Calibration intervals

During the first 5 hours, the 2P MSS calibration is performed every two hours, between 5 and 24 hours every four hours[1]. Thereafter it will occur at the set 2P interval and is automatically performed as “1P-MSS-2P“ or “2P-Spec. Cal“ calibration.
Every 15 minutes during the first 4 hours after an MSS polarization, the 1P MSS calibration is performed, i.e. the 1P MSS calibration is performed 15 minutes after the automatic “1P-Spec. cal“.

System stop, economy mode

After the program MSS SOL_D has been started, the sensor is flushed sufficiently in economy mode and system stop to keep it operational (flushing intervals remain active).
Even with a Waste alarm or Solution D alarm, the fill levels were calculated so that sufficient fluid or space (Waste) is available to keep the sensor operational for a minimum of 1.5 days (for glu/lac operation) or 12 hours (for glu/lac/urea operation).

NOTE: *The sensor flushing procedure is not performed during power failure, with an open measuring chamber cover or bottle compartment cover or when test level actions are being performed, i.e. enzyme migration is possible.*

[1] with urea only

MSS Ref. calibration (AVL OMNI 7 to 9)

This cycle is performed between MSS Int/1P/Slp calibration cycles and after measurements and wash cycles in case of repeat MSS Ref. calibrations. Therefore, it has a modular setup:

- washing of MSS measuring chamber with solution D
- filling of MSS measuring chamber with solution D
- aspiration of Reference solution (with urea only)
- depending on preceding procedure:
  - empty reservoir via V21
  - ash bypass/sample distributor, converting line and empty FMS

Washing and filling the MSS measuring chamber with Solution D

Washing

(See Fig. 16). During this procedure, the peristaltic pump aspirates clockwise with both tubes at the measuring chamber (V14 closed). Valves VSI and VSO are opened.
From an air reservoir between PP cartridge and sample channel output, a pump tube leads air back into the sample channel from the top.
Here, air and solution D are mixed in equal proportions to wash the measuring chamber.
Duration: a few seconds.

Filling

(See Fig. 17). For the filling procedure, V17 is switched. The air supply is switched away from the sample distributor to ensure that no air is added during the subsequent filling process.
Filling of the measuring chamber is evaluated with the conductivity measurement. When solution is flowing, a stable (no airbubble movement) and plausible value must be measured between MCI and MCO. If this is not possible within a certain time limit, aspiration error 1 is displayed (see chapter 9, "Aspiration status codes during measurement").
The fluid column stops when the peristaltic pump stops and the inlet valve VSI closes, and is thus positioned.
If the conductivity measured during flow does not change significantly after the inlet valve closes, the system detects insufficient filling of the measuring chamber and displays aspiration error 2 (see chapter 9, "Aspiration status codes at calibration").

Aspiration of Reference solution (with urea only)

At the beginning of this procedure, the measuring chamber valve output (VSO) is still open and the measuring chamber valve input (VSI) is already closed. Before the Reference solution valve (V8) is opened, the peristaltic pump creates some mbar of under-pressure, to prevent the flow-back of the Reference solution column when the Reference solution valve is opened.
After the Reference solution valve has been opened, the solution is slowly aspirated until the exchange of the rear mixture column against the Reference solution is detected by virtue of a significant increase in conductance between MCI and MCO.
If the necessary increase in conductance is not detected within the time limit, aspiration status code 3 (see chapter 9, "Aspiration status codes").
Finally the Reference solution-valve and the valve output (VSO) are closed. If an obvious change in the conductance occurs, the aspiration status code 4 (see chapter 9, "Aspiration status codes") is given.

Repeating the D-cycle

In the calibration cycle after Solution 3 and in the measurement cycle after samples with high concentrations (12 mmol/L), the Solution D-cycle is repeated for faster sensor recovery. Only this second Solution D-cycle is used for the calibration or measurement value calculation.

Empty air reservoir (SD-PP-cartridge) via V21

(See Fig. 18). This air reservoir is necessary for all MSS calibrations.
Since the sample inlet path is filled, aspiration takes place via V21 and FMS (V19).

Calculation of calibration and measurement slope

After completion of the signal detection, the last reference value ist used to establish the calibration and measurement slope of the previous MSS Int/1P/Slp calibration or measurement.
Thus, aspiration or calibration problems (calc.3) during the reference cycle appear in the MSS Int/1P/Slp calibration or measurement as “Ref. n. OK“, which results in a repetition of the Int/1P/Slp with a reference point cycle.
Reproducibility problems in the reference point only increase the reference point calibration cycles and are not used for slope calculation.

To complete MSS calibration:

Wash Bypass/SD, converting line and empty FMS

(See Fig. 14). To return to "Ready", the sample paths must be washed and dried. This is done with an abbreviated wash cycle. To establish a complete Standby mode, the converting line must be washed (vacuum: V3, V14) and the FMS must be emptied (V17).

MSS Int/1P/Slp calibration (AVL OMNI 7 to 9)

This cycle is always started with valid reference point.

- Prepare Int/1P/Slp
- Positioning at sample sensor SS4
- aspirate Int/1P/Slp into the MSS measuring chamber
- push back residual solution in the sample distributor

Start status

When the measuring chamber is filled with Solution D and the MSS Ref. calibration is OK, the MSS Int/1P/Slp calibration starts, if not, the MSS Ref. calibration starts.

If another Int/1P/Slp cycle is scheduled:

Prepare Int/1P/Slp

(See Fig. 19). Via the respective T&D position, solutions 1, 3 or 5 are apsirated to sample sensor SS6 (center sensor in the T&D module).
After adding a small segment of solution, the T&D is undocked and the solution segment positioned at sample sensor SS2. In case of error, aspiration error 14 is displayed (see chapter 9, "Aspiration status codes during measurement").
During the procedure, the air reservoir is emptied.
If during an MSS 2P calibration, solution 1 is apsirated for the first time, the intially aspirated segment is fully aspirated as pre-package (through sample distributor).

Positioning at sample sensor SS4

(See Fig. 20). Aspiration takes place via sample distributor V15 and V17.
If positioning at sample sensor SS2 is not possible, MSS aspiration error 20 is displayed (see chapter 9, "Aspiration status codes during measurement").

Aspirate Int/1P/Slp into MSS measuring chamber

This aspiration procedure starts with the sample column tip being positioned at sample sensor SS4. The peristaltic pump aspirates via VSI, VSO and converting line.
To produce a rinsing effect to minimize carryover, air is added via V17 and V15 through a return PP tube, at the beginning of the aspiration process (see Fig. 21).
The aspiration process is monitored via the flow of calibration solution (conductivity). If the flow is not interrupted at a certain time, MSS Aspiration Error 2 is displayed (see chapter 9, "Aspiration status codes during measurement").
V17 is switched from rinsing to filling (see Fig. 22). Positioning of the solution is controlled via contact path MCI-MCO. If the preset timeout is exceeded, MSS aspiration error 1 is displayed (see chapter 9, "Aspiration

status codes during measurement"). The positioning process of the solution is completed when VSI and VSO close.

Push residual solution back in SD

(See Fig. 23). To empty the sample path for the subsequent MSS Ref. cycle, solution residues are pushed back in the sample distributor to about VII.

Phases of diverse AVL OMNI™ actions

- Mixing system calibration

  Solution B:
  - FMS measurement or B preparation
  - BG -initial filling
  - ISE initial filling

  until a result is reproduced or the cycle limit has been reached:
  - Rinse BG (if already ok alternative waiting time)
  - Rinse ISE (if already ok alternative waiting time)
  - Completion (follow-up)

  Solution C:
  - C preparation
  - BG initial filling
  - ISE initial filling

  until a result is reproduced or the cycle limit has been reached:
  - Rinse BG (if already ok alternative waiting time)
  - Rinse ISE (if already ok alternative waiting time)
  - Completion (follow-up)
- O_2-Zero calibration
- O_2-1P calibration
- Cleaning
- Conditioning
- Empty Reference electrodes
- Rinse Reference electrodes

Mixing system calibration

This calibration mainly consists of 3 parts:

- Calibration of conductance for Solution B (when calibration with BG including FMS measurement)
- Calibration of conductance for Solution C
- 1P liquid calibration for electrode conditioning

Calibration of conductance for Solution B

FMS measurement or B-preparation

A FMS measurement is performed even when the conductance measurement path on the BG module is calibrated. Otherwise only the aspiration of Solution B is prepared.

FMS measurement

This procedures begins with the emptying of FMS over V19 (air), cross piece, FMS air bubble trap and V17. Then the aspiration path for measurement is switched through (V19, cross piece, FMS air bubble trap, V21, VBI and VBO). After a brief equalization of pressure (approx. 2 seconds) the time measurement is started and switched to Solution B (V19 air closed, mixer at B).
Solution B in the BG measuring chamber is defined by the conductance measurement path within approx. 8 to 13 seconds. If this does not occur, the FMS volume error (see chapter 9, "Troubleshooting") is given and the system goes into System stop.
At the end of this phase, Solution B in the FMS is aspirated over the sample distributor and is switched through for the following conductance calibration cycles, whether FMS was measured, or only Solution B was prepared.

BG initial filling

For the BG initial filling of a module for a mixing system calibration, the measuring chamber is washed and filled similarly to an electrode calibration cycle. In other words, during the first seconds an air-solution mixture is aspirated through the measuring chamber. Thereafter, the measuring chamber is filled with the proper solution.

ISE initial filling

The ISE initial filling takes place in the same manner as the BG initial filling. The following is performed until a result is reproduced or the cycle limit has been reached:

- Rinse BG (if already ok alternative waiting time).
  Only the liquid column is aspirated in this case (switched through back into the bottle).
- Rinse ISE (if already ok alternative waiting time). Runs like the BG rinse procedure.

Completion (follow-up)

At the end of the Solution B-conductance calibration, the built-up liquid column is removed. The FMS (V19 and Mixer) are switched to air and are emptied over V17. The sample distributor is emptied over V15 and V17 "as usual".

Calibration of conductance for Solution C

All procedures are identical to the calibration with solution B.
Only difference: No FMS measurement is required during the preparation phase.

O_2-Zero calibration

This calibration is built-up like a "BG-only" measurement and differs only in the following points:

- The solution is not introduced like for a measurement, but is aspirated over the T&D Pos.5 to sample Sensor SS2 (general distribution starting point).
- At the beginning of the positioning in the measuring chamber, washing is performed, similar to calibration cycle (2 seconds mixing air)
- After the positioning in the BG measuring chamber, an extra waiting time of approx. 10 seconds is added.

In this special case, if requested, a Na-conditioner will be aspirated at this time, during the system calibration process. The measuring chamber surroundings are briefly washed and dried and Solution 2 is aspirated over the T&D Pos.7 to SS2. The further procedure is identical to the ISE-only measurement.

O_2-1P calibration

The room air is slowly aspirated through the BG measuring chamber for the O_2-1P calibration. The air aspiration path is switched through over the T&D Pos.3, SS2, SS1, VBI, and VBO.
The necessary FMS mixture for the following electrode conditioning is mixed immediately prior to the air aspiration cycle.

Auto. cleaning with Solution 6

The cleaning procedure is set up like a measurement, during which cleaning solution is aspirated via T&D position 11. It is part of the system calibration. The selection of the measuring chambers to be cleaned is controlled by the sample counter.

Conditioning

Conditioning is an "ISEonly" measurement with the over T&D Pos.7 aspirated solution 2 (pre-package!). Is performed daily, under time control, within a system calibration.

Empty Reference electrodes

This process takes place in the background, in otherwords, the system remains ready for measurement. The cycle can be terminated at any time and is immediately ended when a sample container is detected on the T&D or when a key is pressed.
This procedure is called up in "**READY**" after 2 minutes, which means that this cycle is called up one time, between the half-hour 1P calibrations, when no measurements are made.
In this case, only the sample channel of the Reference electrode are emptied when air is aspirated over the FMS, the Junction and the VxO.

Rinse Reference electrodes

This process also takes place in the background, in otherwords, the system remains ready for measurement and can be terminated at any time.
The Reference electrodes of each module and their connections are rinsed with Reference solution sequentially, during their cycle. The sample channels of the Reference electrodes are emptied thereafter. This procedure is called up in "**READY**" after 15 minutes

Tubing diagrams

Basic setting of valves in "Ready" mode and at beginning of valve test

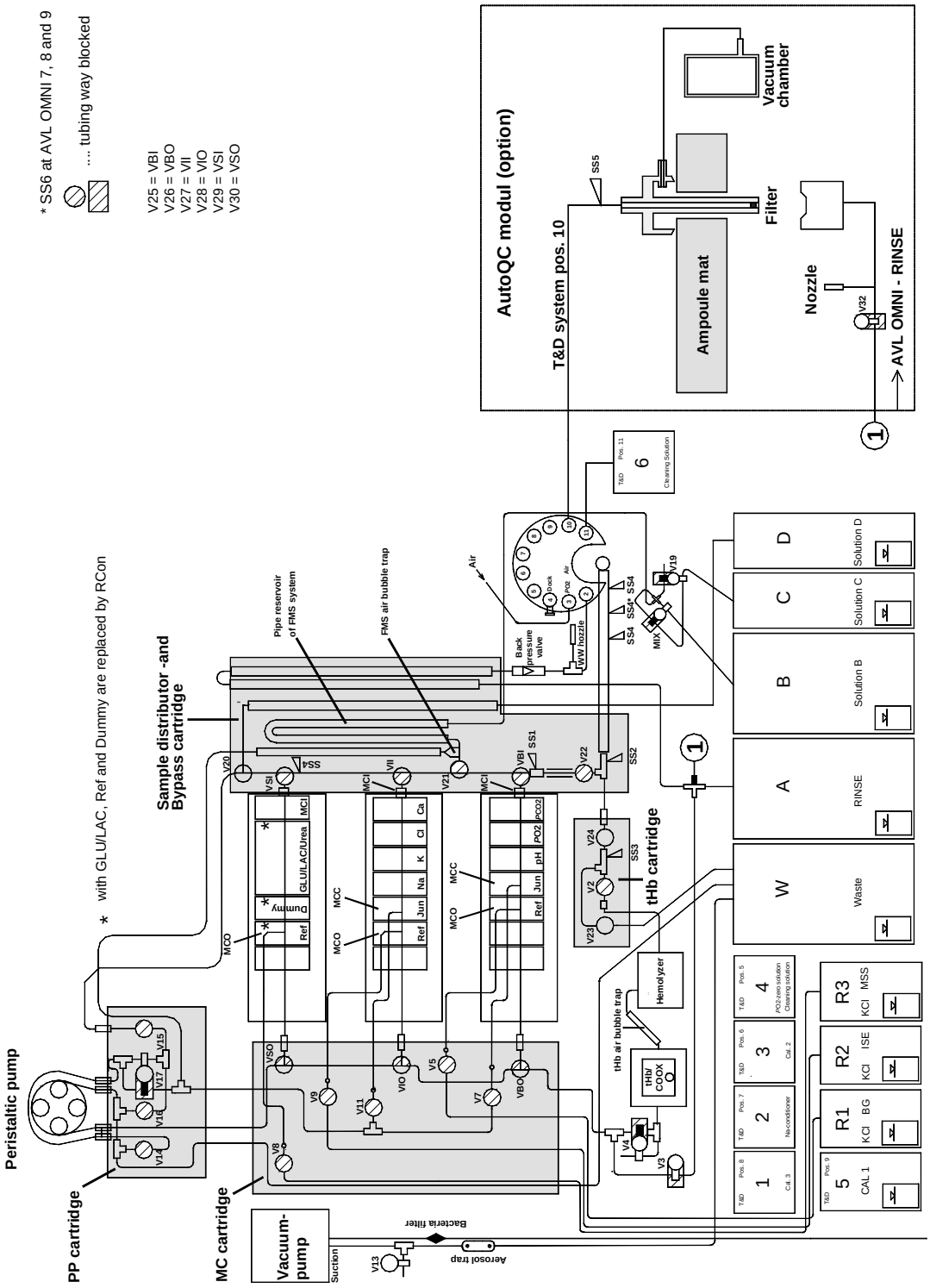
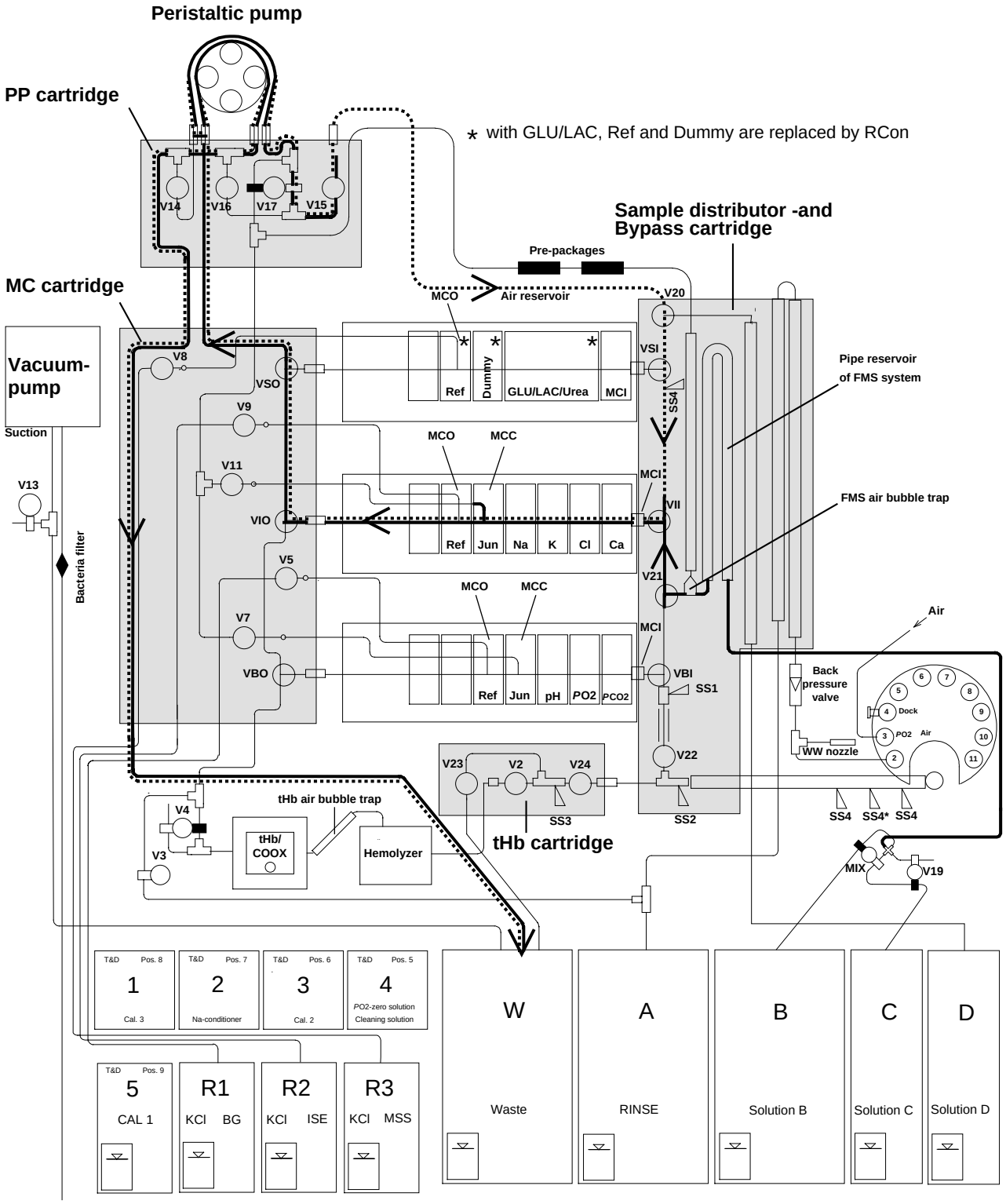


Fig. 1: Tubing diagram 1 (with Solution 6)

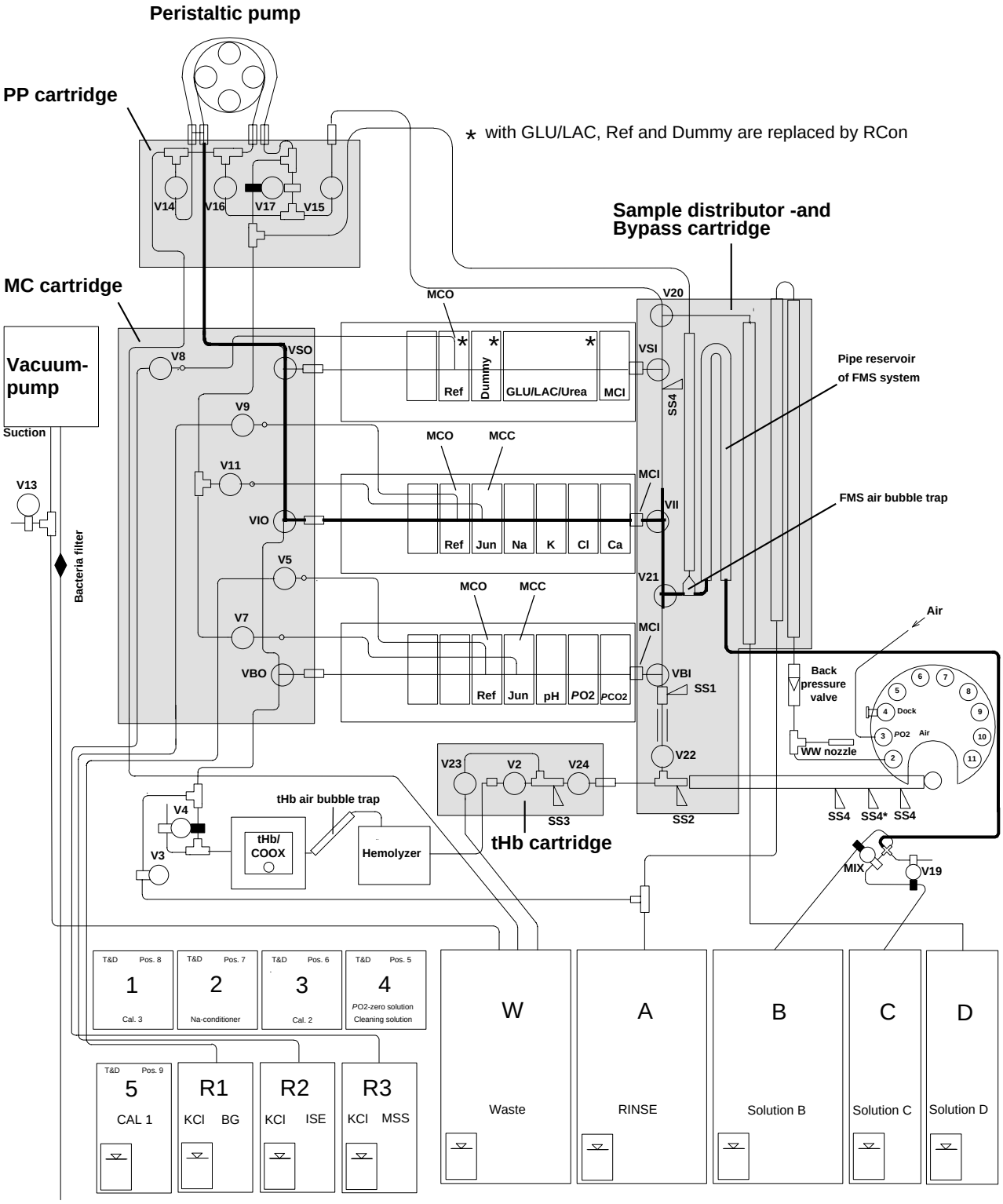
Washing the measuring chamber (shown for ISE)



* SS6 at AVL OMNI 7, 8 and 9

Fig. 2: Tubing diagram 2

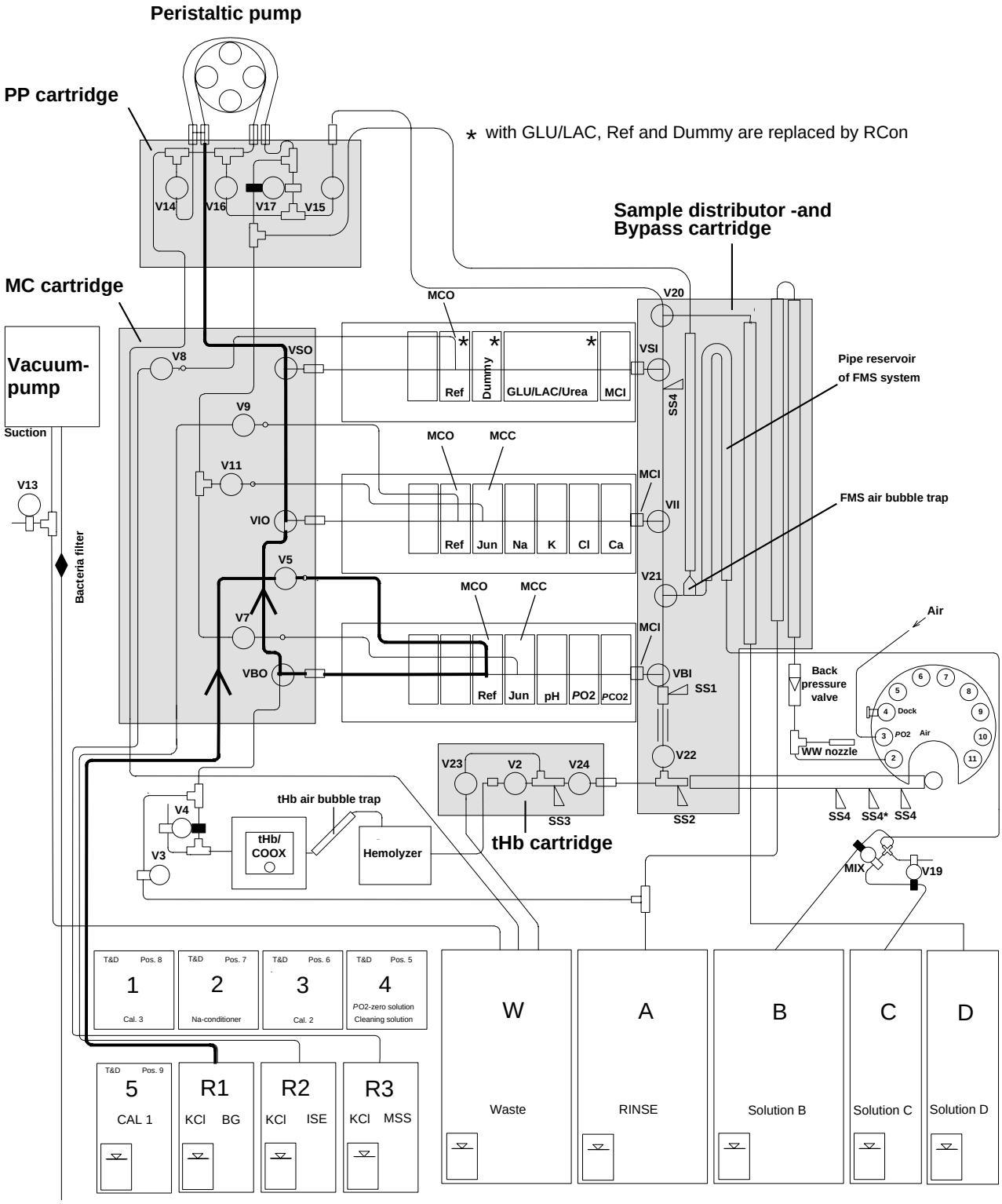
Filling during calibration



* SS6 at AVL OMNI 7, 8 and 9

Fig. 3: Tubing diagram 3

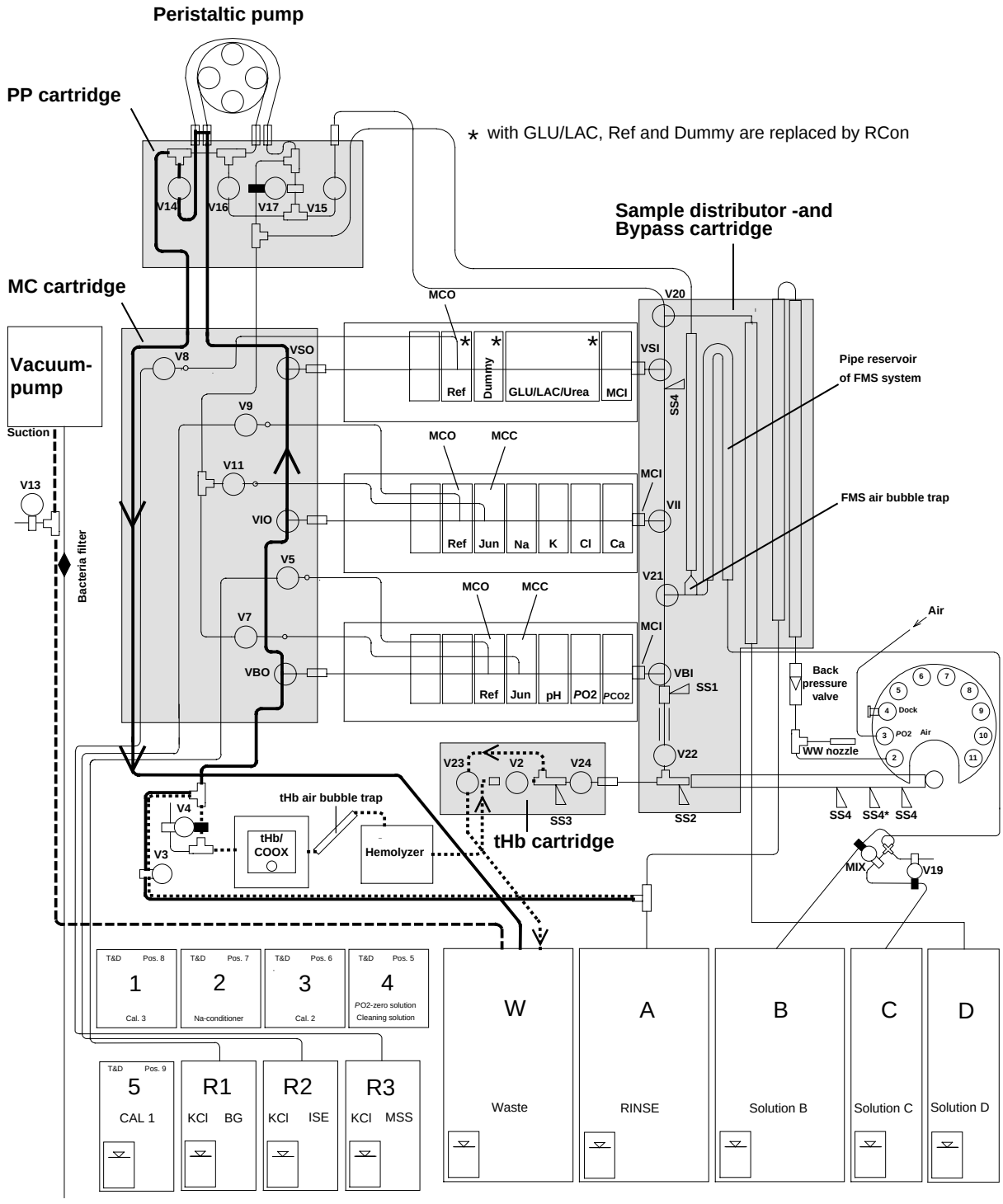
Aspiration of Reference solution during calibration



* SS6 at AVL OMNI 7, 8 and 9

Fig. 4: Tubing diagram 4

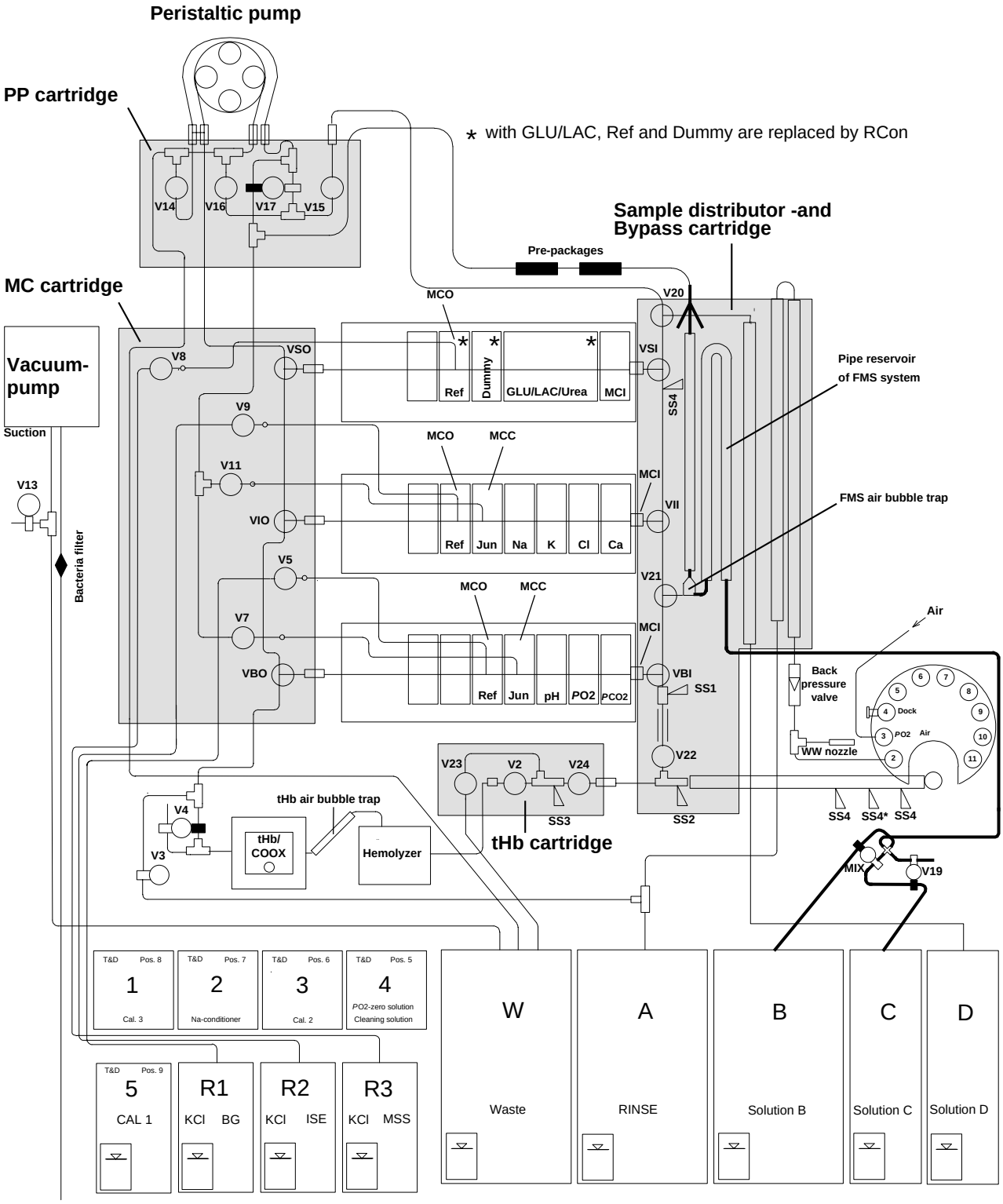
Washing the converting line (————) and re-washing off tHb- or COOX module (·····), vacuum (·····),



* SS6 at AVL OMNI 7, 8 and 9

Fig. 5: Tubing diagram 5

Preparing B/C mixture

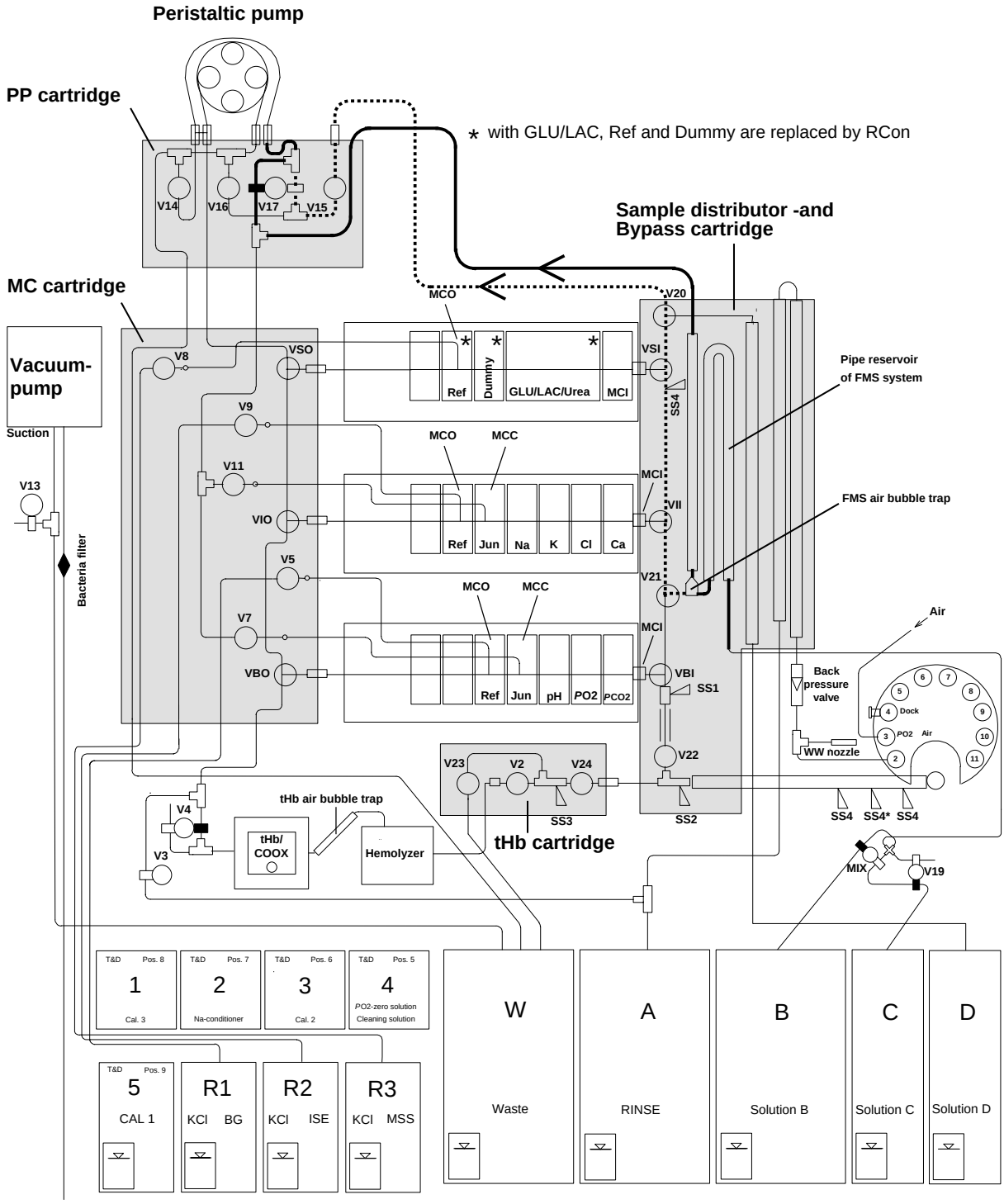


* SS6 at AVL OMNI 7, 8 and 9

Fig. 6: Tubing diagram 6

Follow-up of the FMS

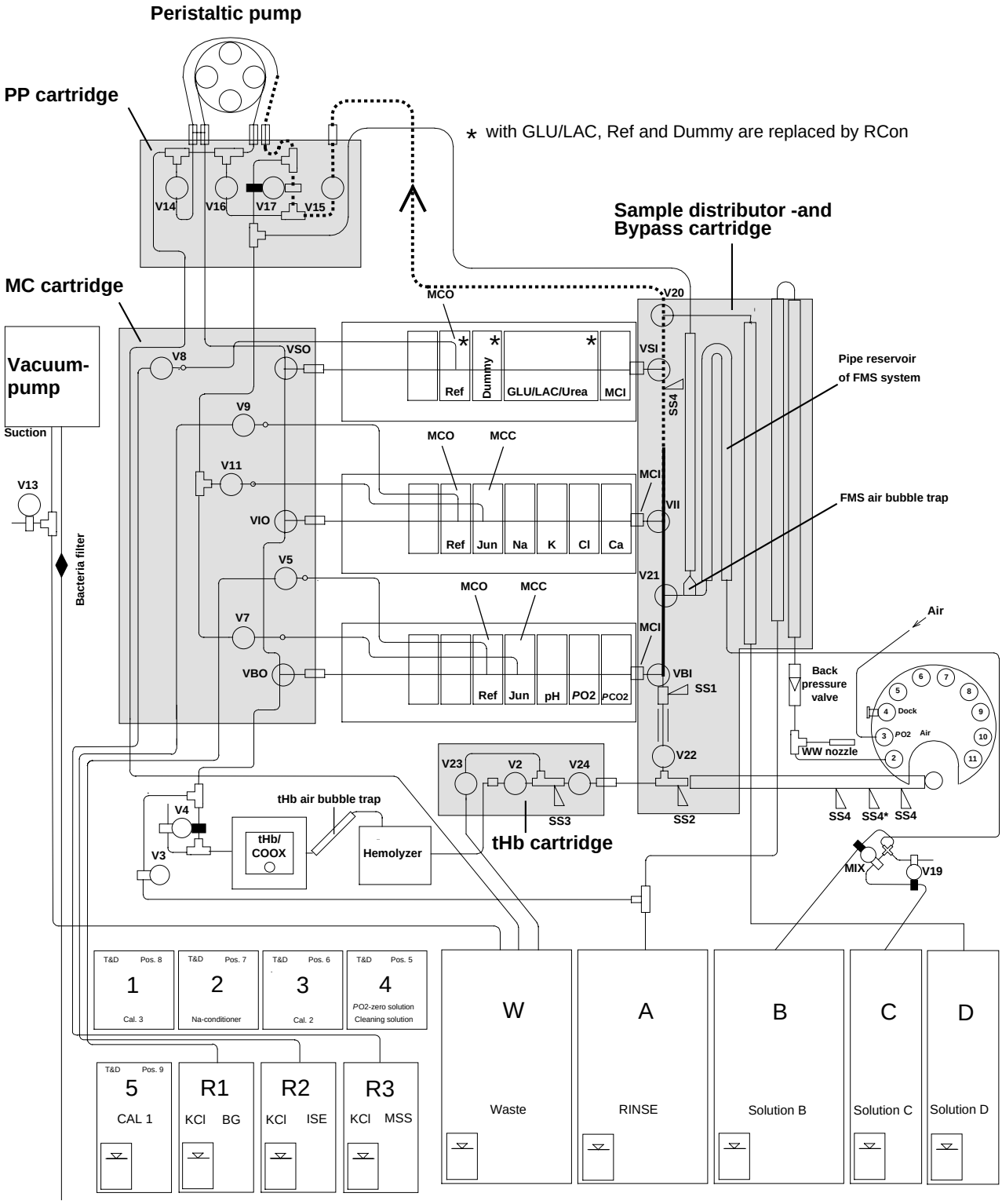
empty lower FMS-pipe (————)
empty FMS-air bubble trap (·····)



* SS6 at AVL OMNI 7, 8 and 9

Fig. 7: Tubing diagram 7

Empty sample distributor and air reservoir

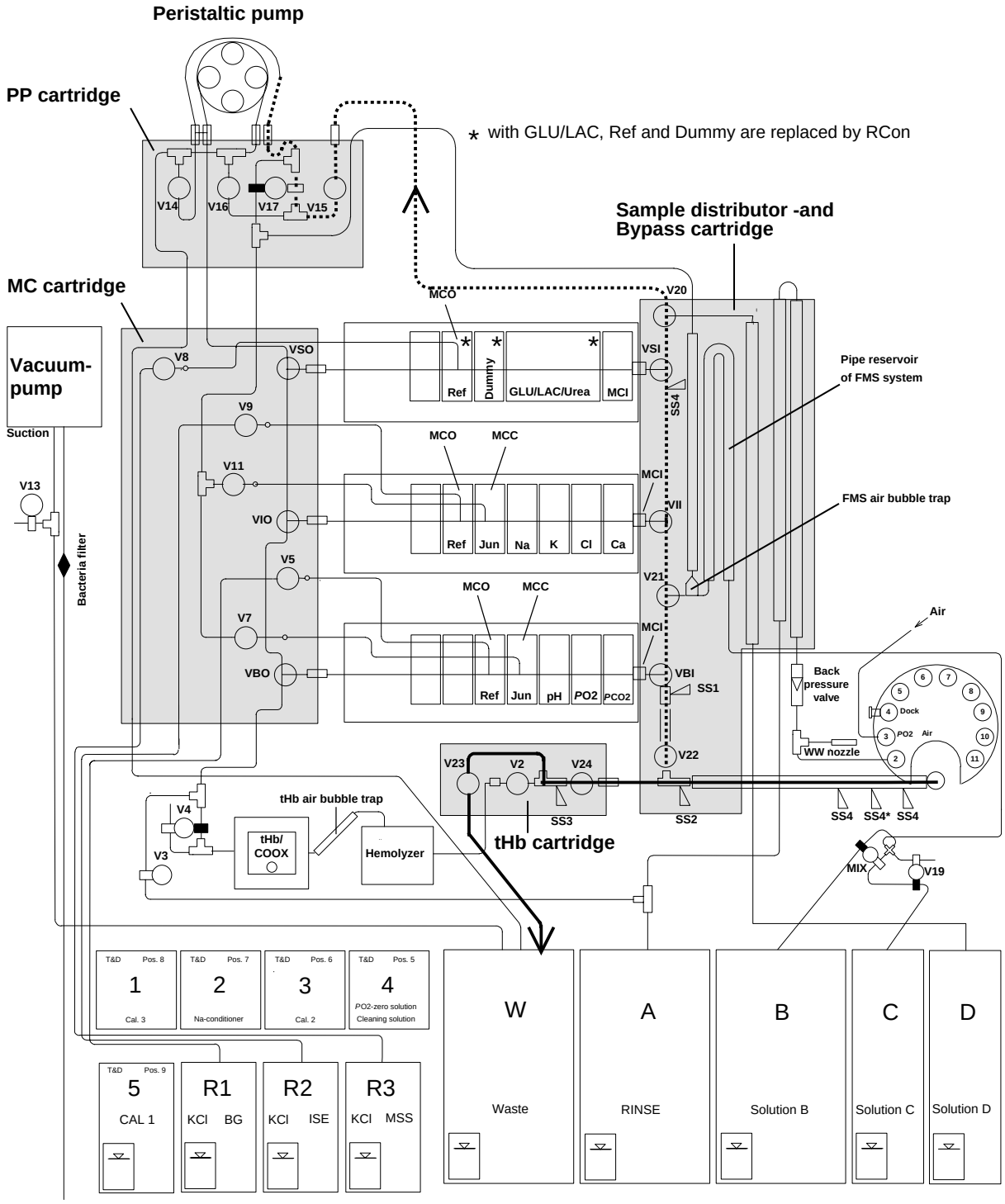


* SS6 at AVL OMNI 7, 8 and 9

Fig. 8: Tubing diagram 8

Sample input

Injection of the sample (————)
Aspiration of the sample (·····)

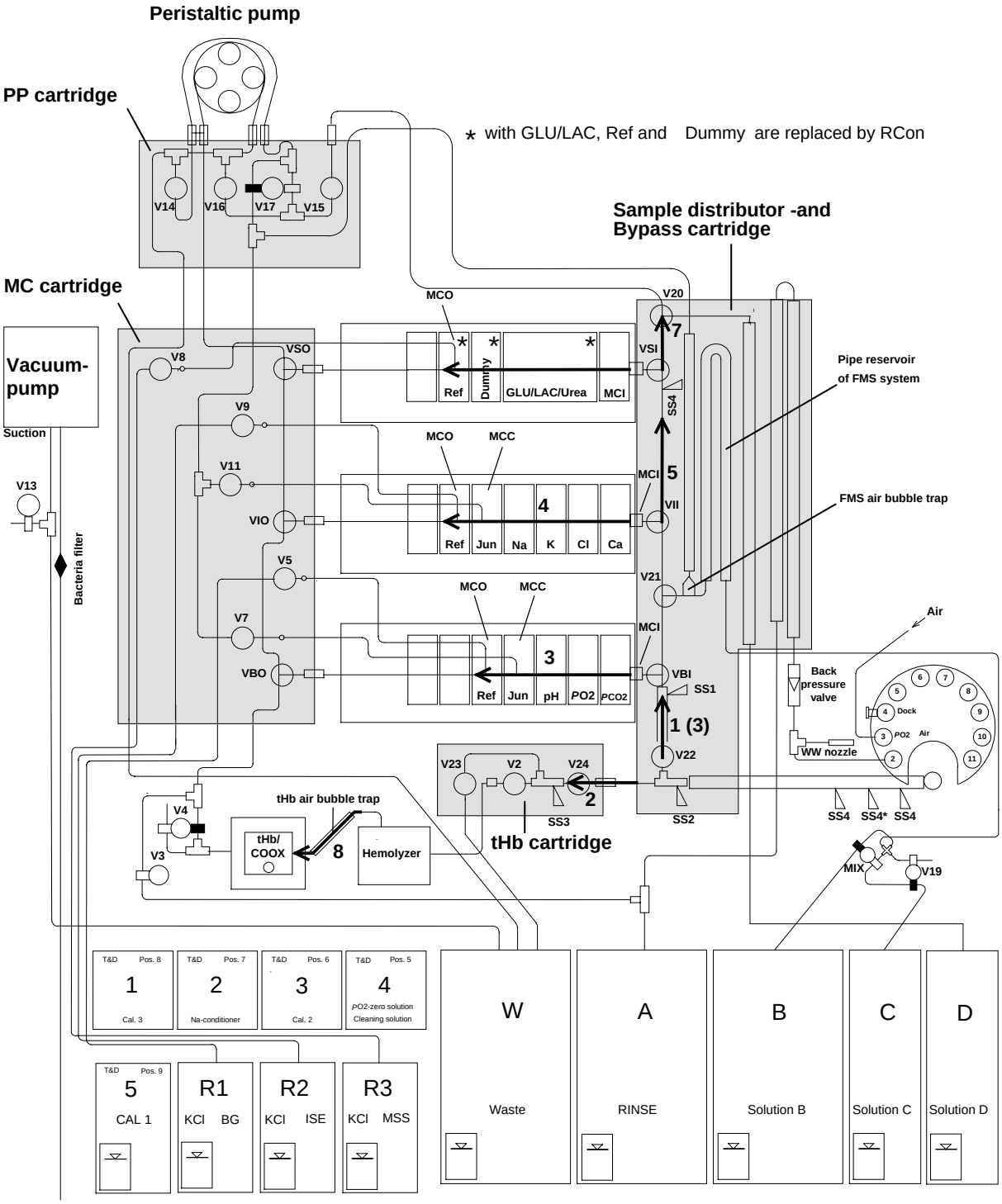


* SS6 at AVL OMNI 7, 8 and 9

Fig. 9: Tubing diagram 9

Sample distribution BG - tHb or COOX - ISE - MSS

1 Separation of BG
2 Separation of tHb or COOX
3 Positioning of BG and separation of ISE
4 Positioning of ISE
5 Positioning at SS4
6 Positioning of MSS
7 Removal of excess sample
8 Positioning of tHb or COOX

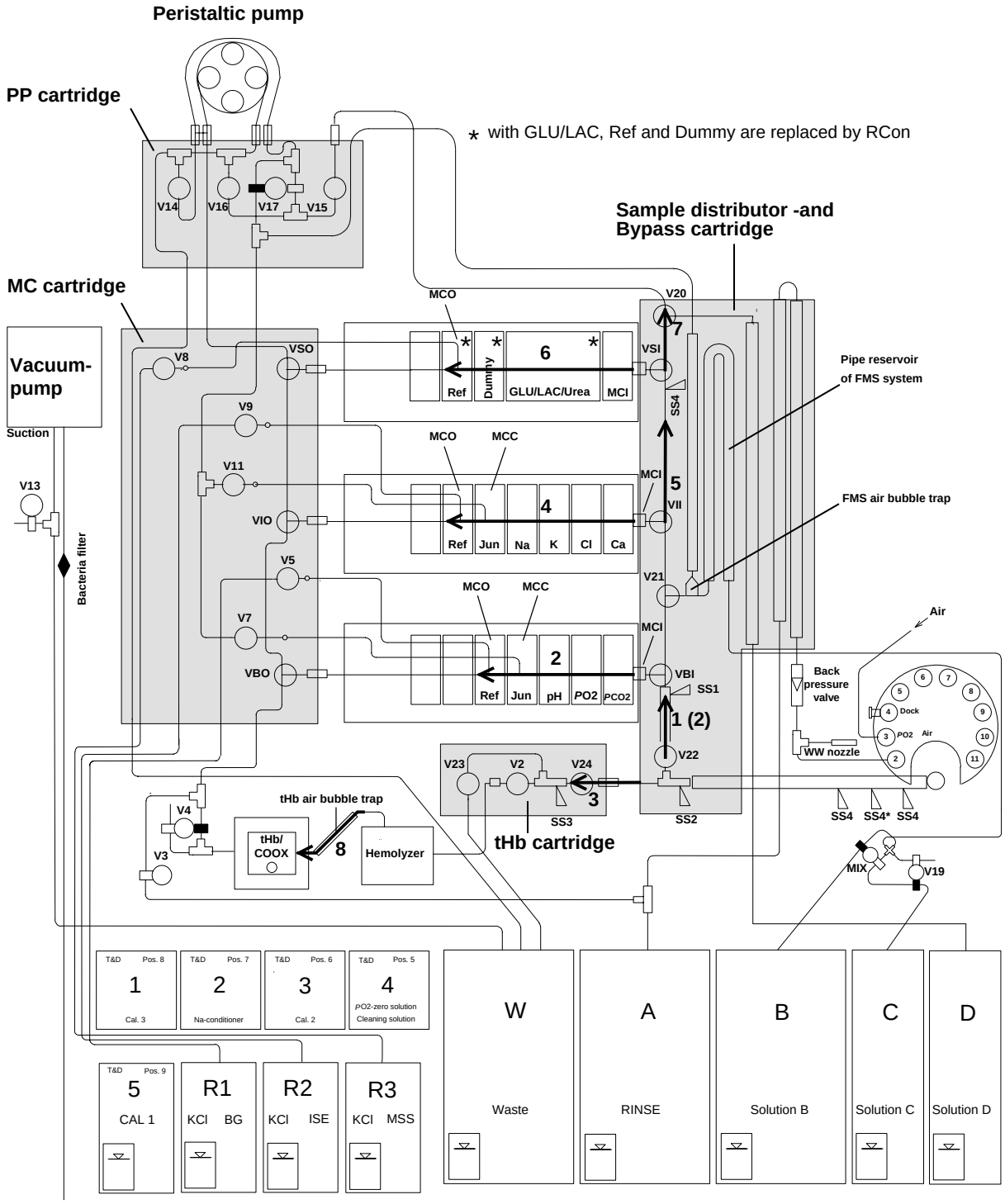


* SS6 at AVL OMNI 7, 8 and 9

Fig. 10: Tubing diagram 10

Sample distribution BG - ISE - tHb or COOX - MSS

1 Separation of BG
2 Positioning of BG and separation of ISE
3 Separation of tHb or COOX
4 Positioning of ISE
5 Positioning at SS4
6 Positioning of MSS
7 Removal of excess sample
8 Positioning of tHb or COOX

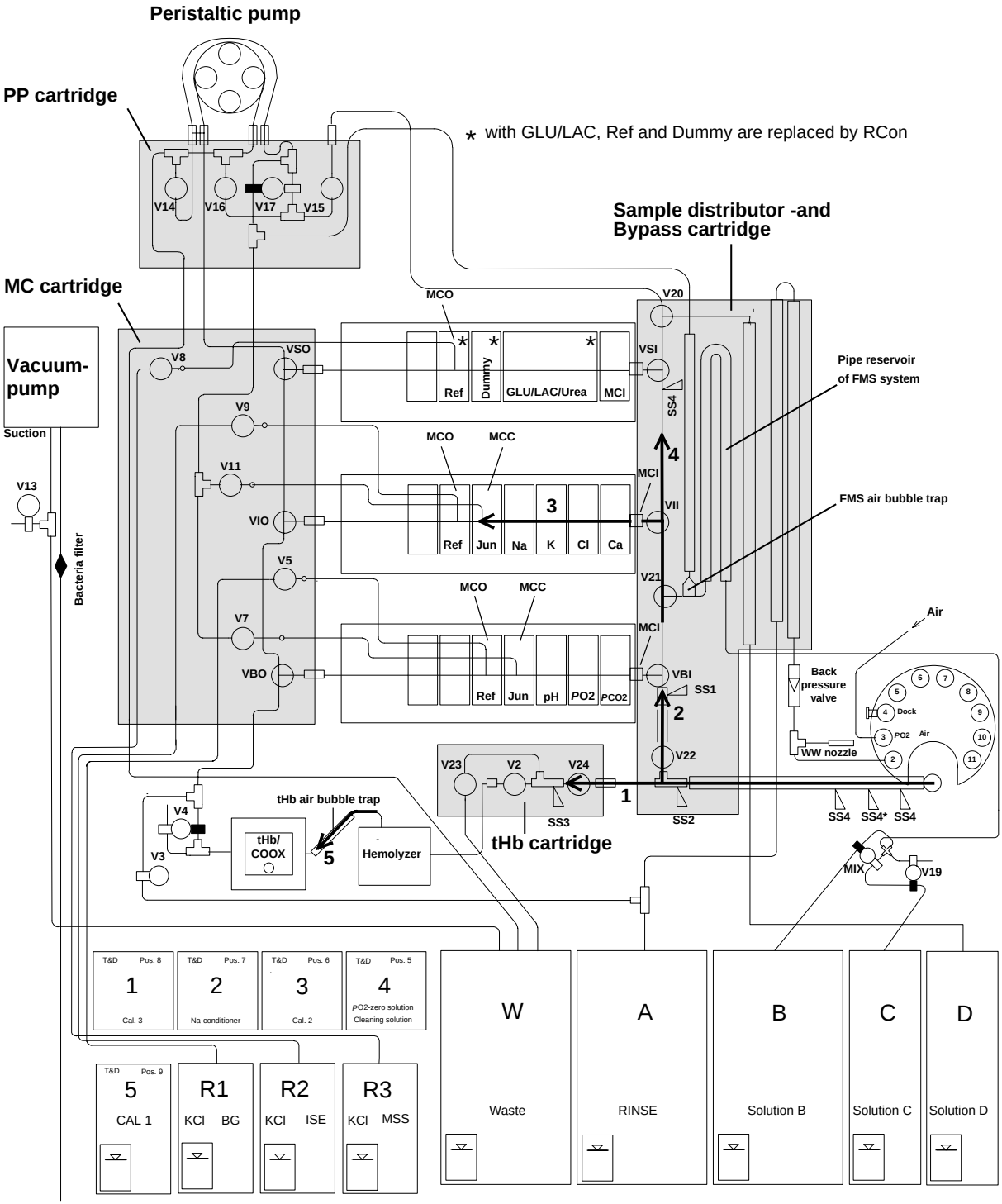


* SS6 at AVL OMNI 7, 8 and 9

Fig. 11: Tubing diagram 11

Sample distribution tHb or COOX - ISE

1 Separation of tHb or COOX
2 Separation of ISE
3 Positioning of ISE
4 Removal of excess sample
5 Positioning of tHb or COOX

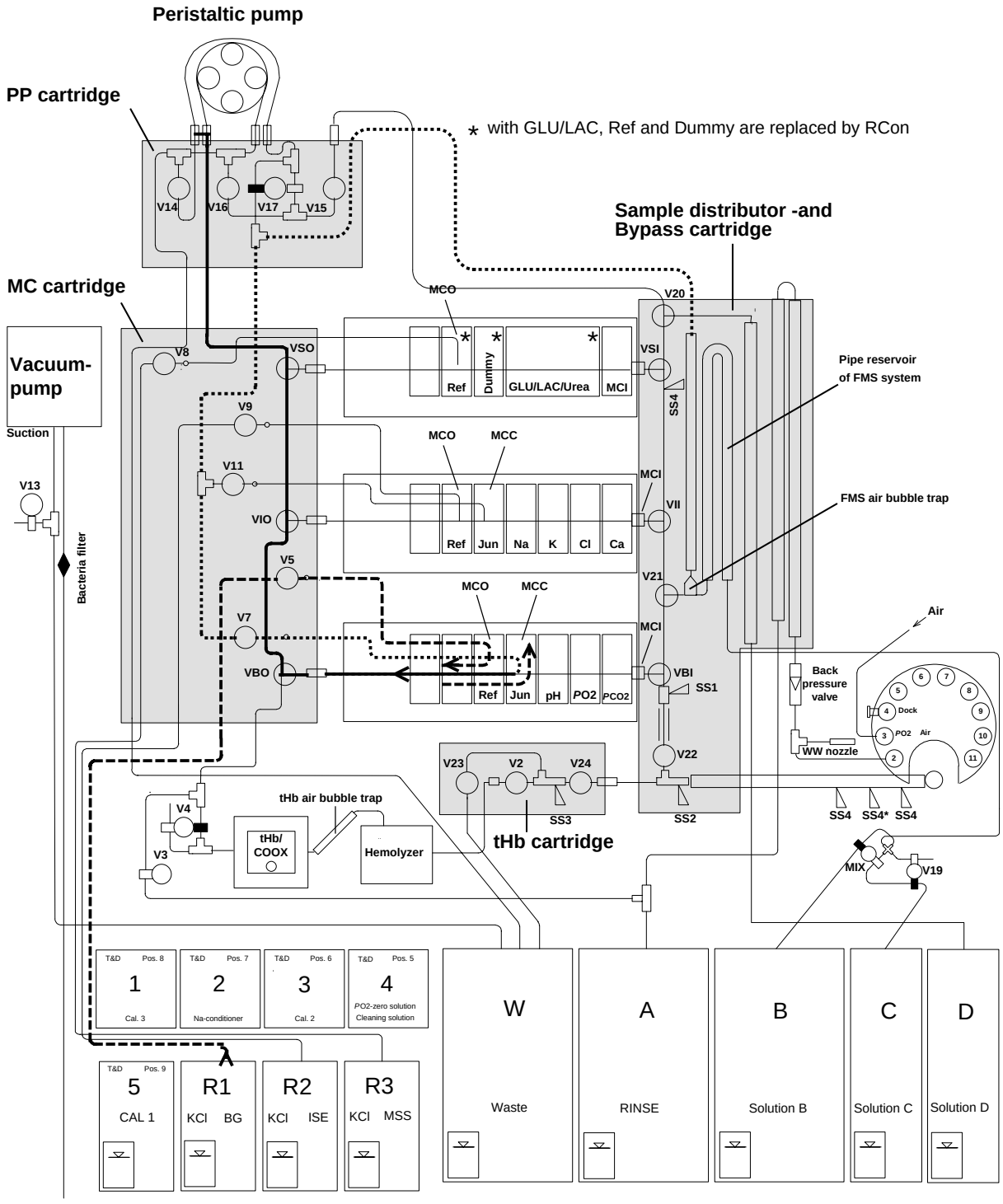


* SS6 at AVL OMNI 7, 8 and 9

Fig. 12: Tubing diagram 12

KCl-aspiration during aspiration of sample

After the sample has been aspirated, the sample part "Junction - Ref. with air" (·····) is sucked away (——————) over the Junction during closed V_I (VII). Thereafter, the Reference solution is pressed into the (·····) measuring chambers over Ref. valves (V5, V6), and lastly the bridge is closed with Reference solution at the Junction. Thereby, the contact with the sample ist established.

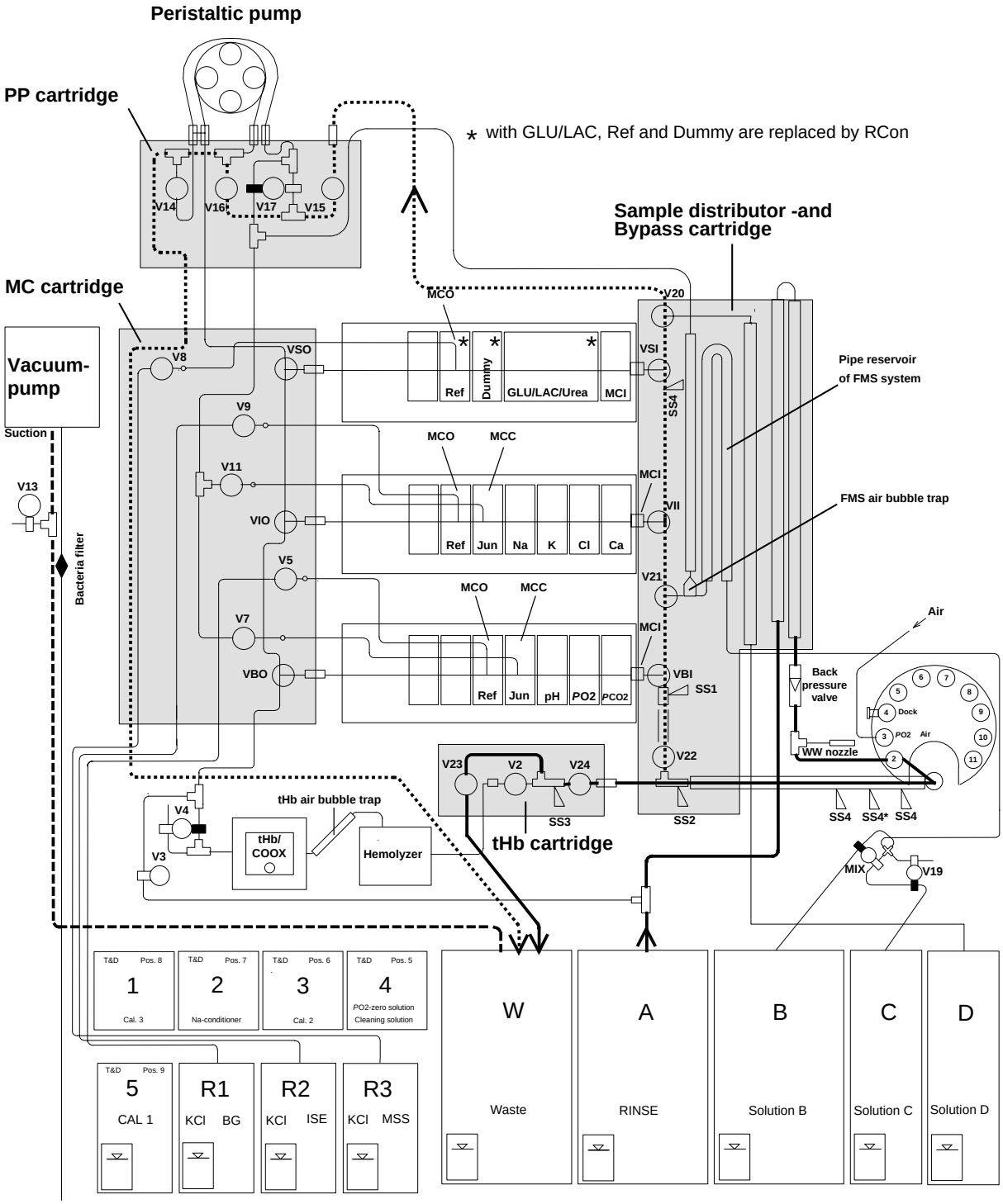


* SS6 at AVL OMNI 7, 8 and 9

Fig. 13: Tubing diagram 13

Washing the measuring chamber surroundings

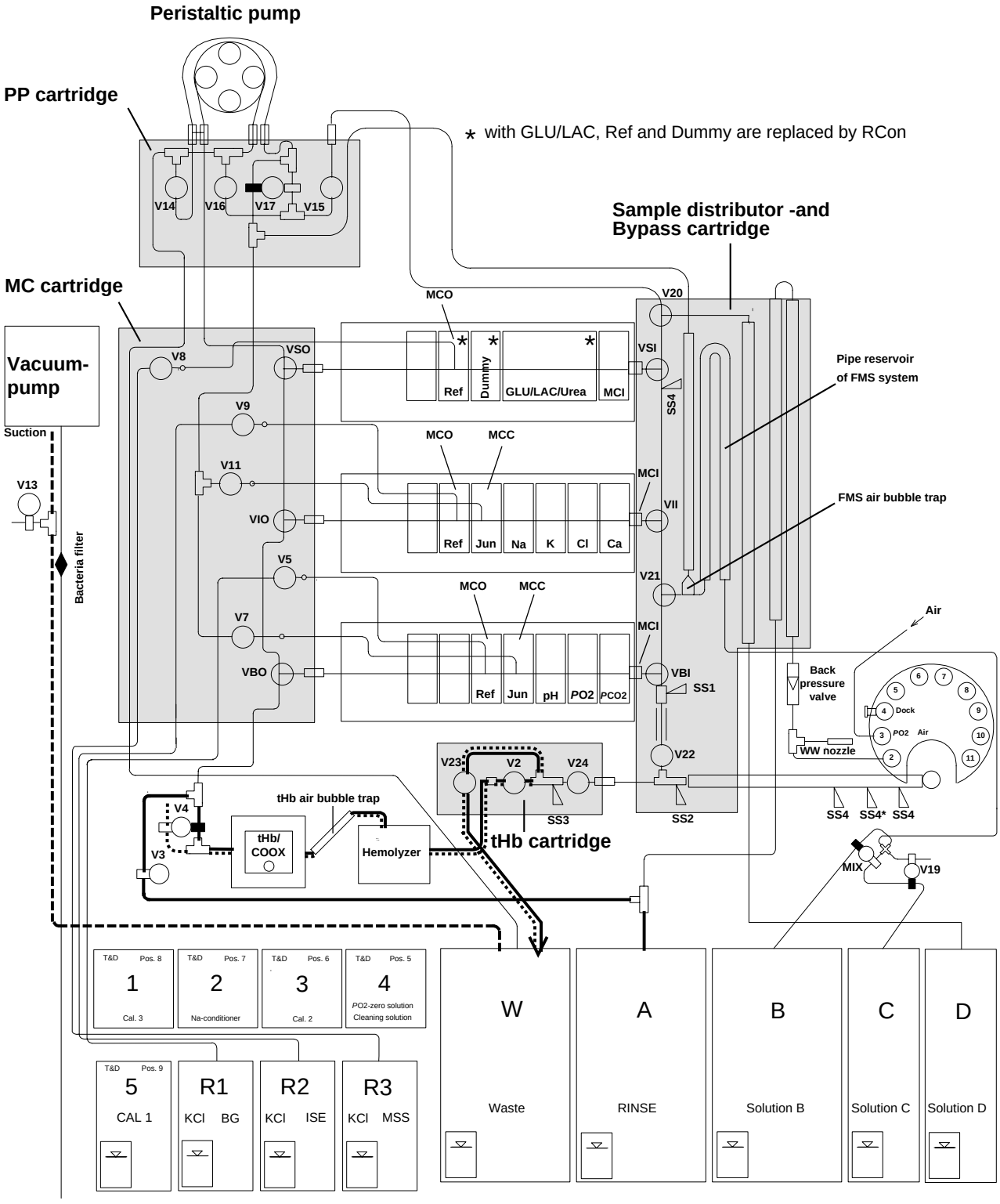
(————) washing bypass
(·····) washing sample distributor
(- - - - -) vacuum



* SS6 at AVL OMNI 7, 8 and 9

Fig. 14: Tubing diagram 14

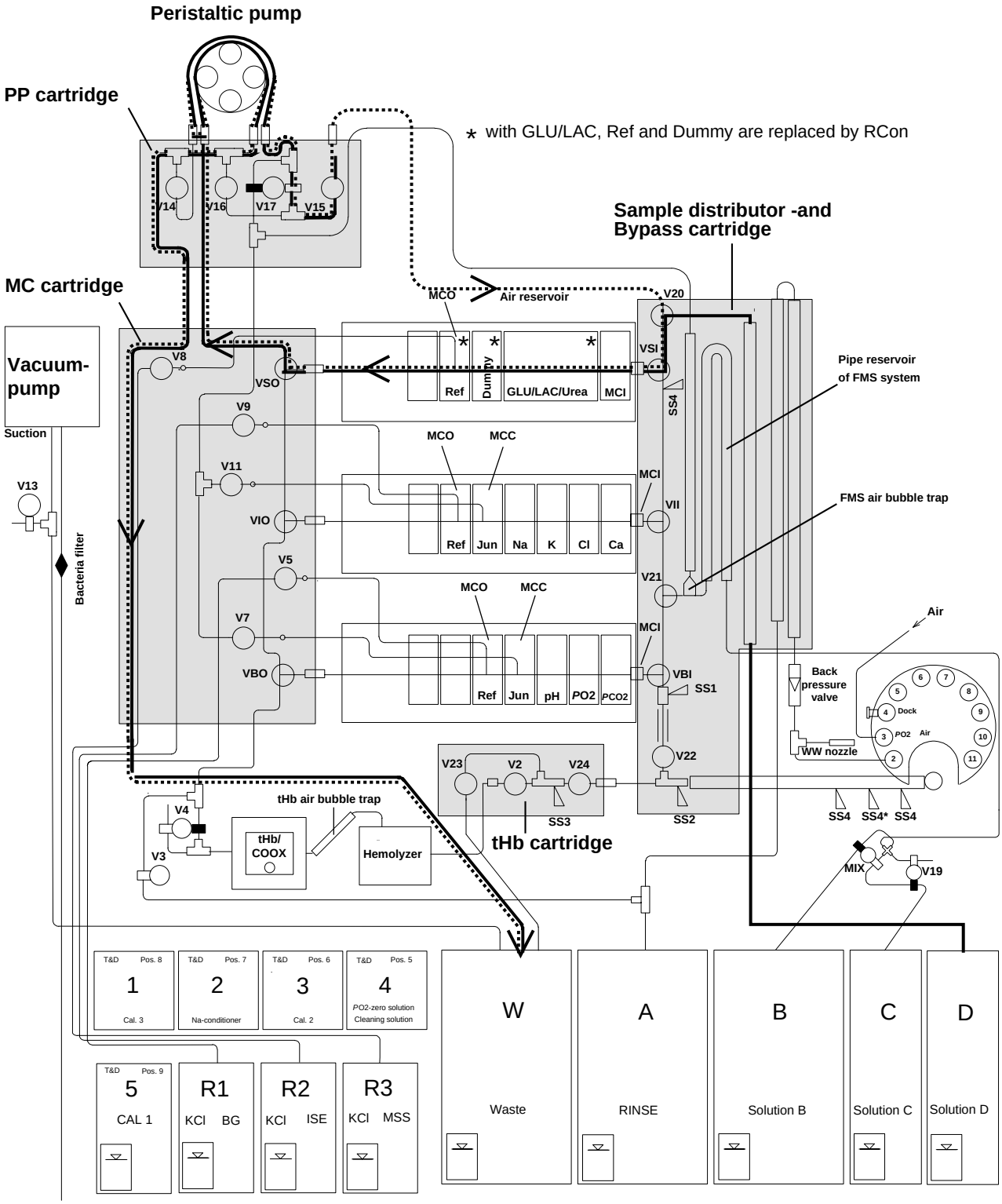
(————) washing tHb or COOX
(·····) drying tHb or COOX
(- - - - - - - - - -) vacuum



* SS6 at AVL OMNI 7, 8 and 9

Fig. 15: Tubing diagram 15

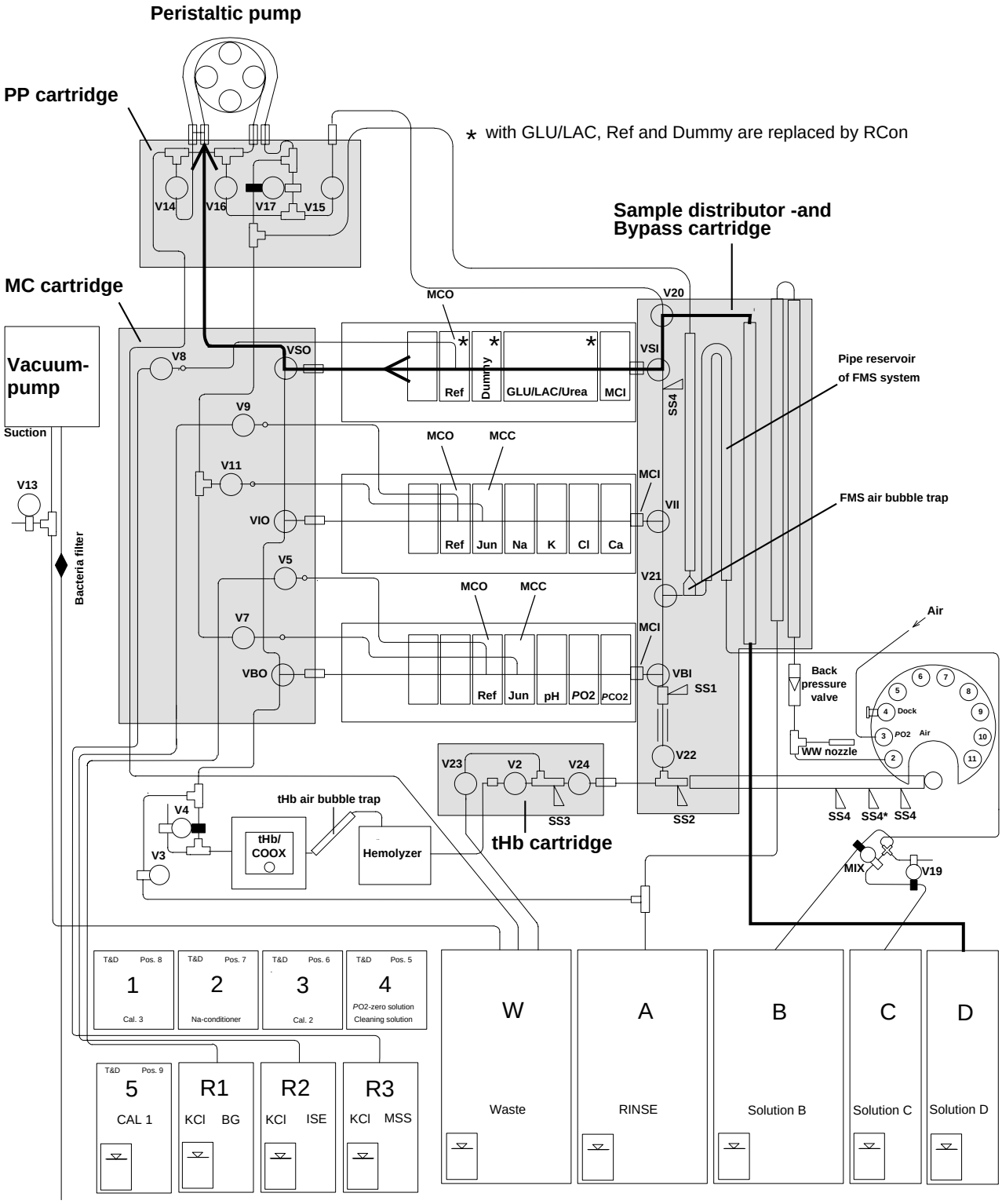
Washing the MSS measuring chamber with Solution D



* SS6 at AVL OMNI 7, 8 and 9

Fig. 16: Tubing diagram 16

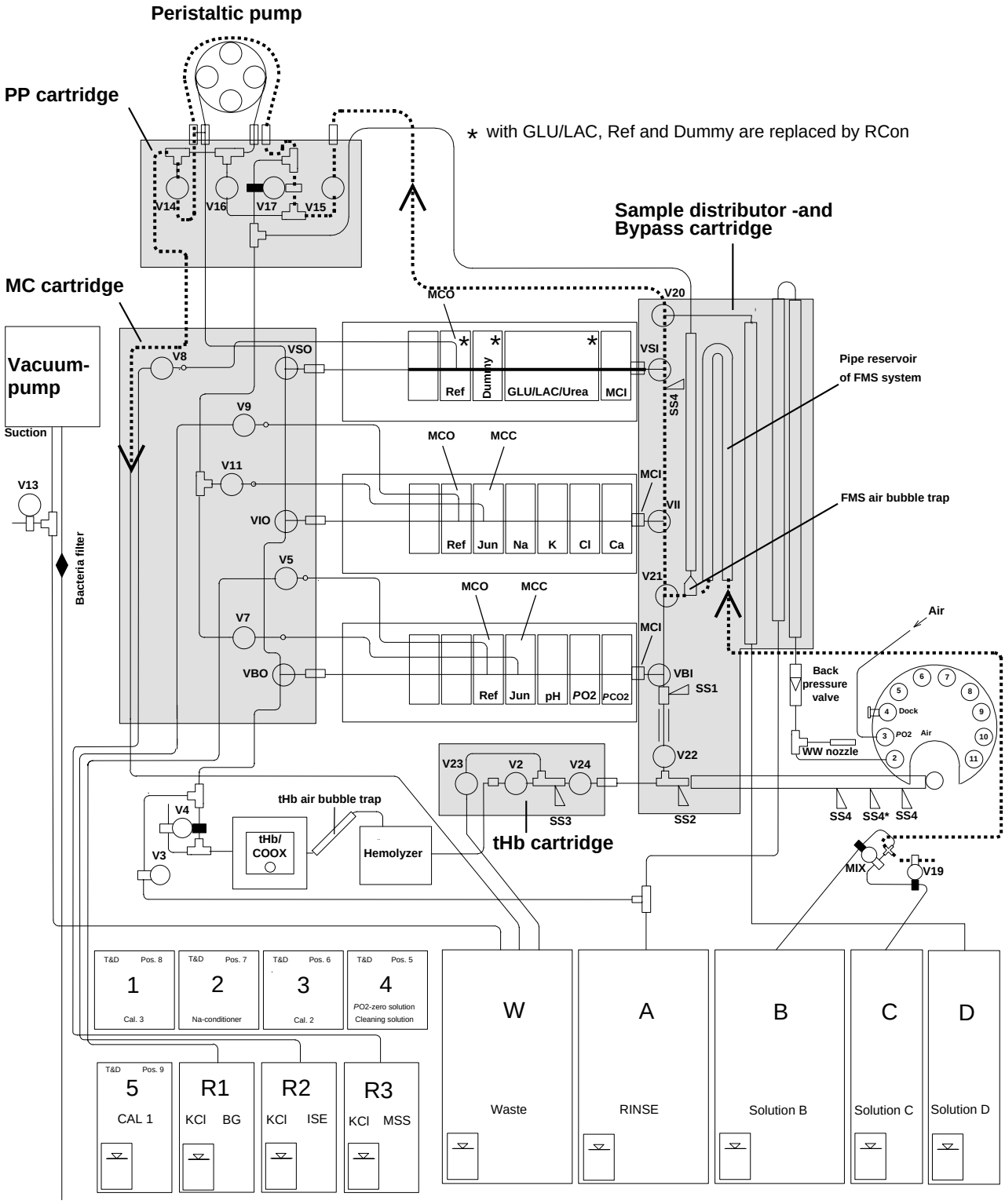
Filling the MSS measuring chamber with Solution D



* SS6 at AVL OMNI 7, 8 and 9

Fig. 17: Tubing diagram 17

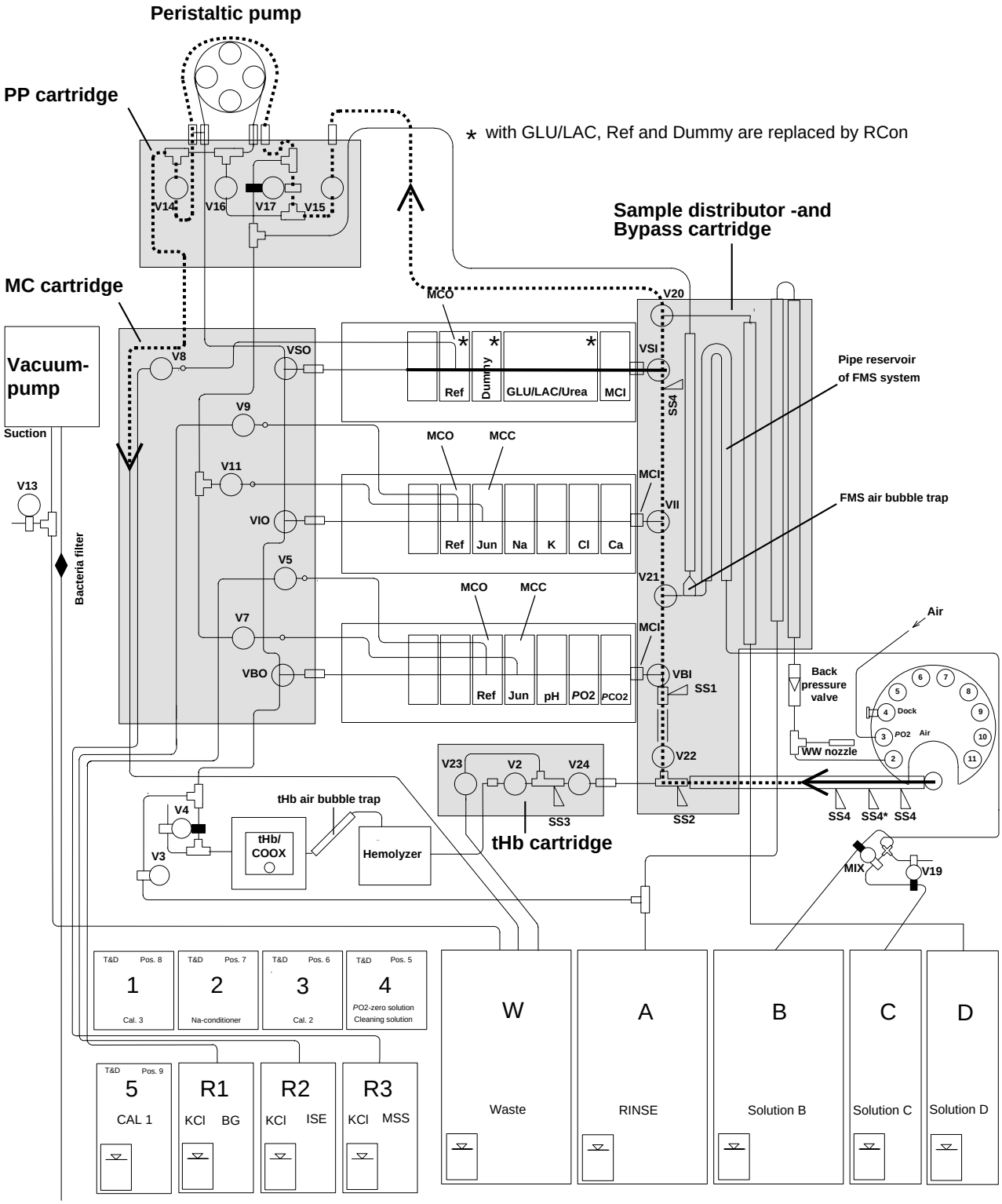
Empty air reservoir (SD/PP cartridge) via V21



* SS6 at AVL OMNI 7, 8 and 9

Fig. 18: Tubing diagram 18

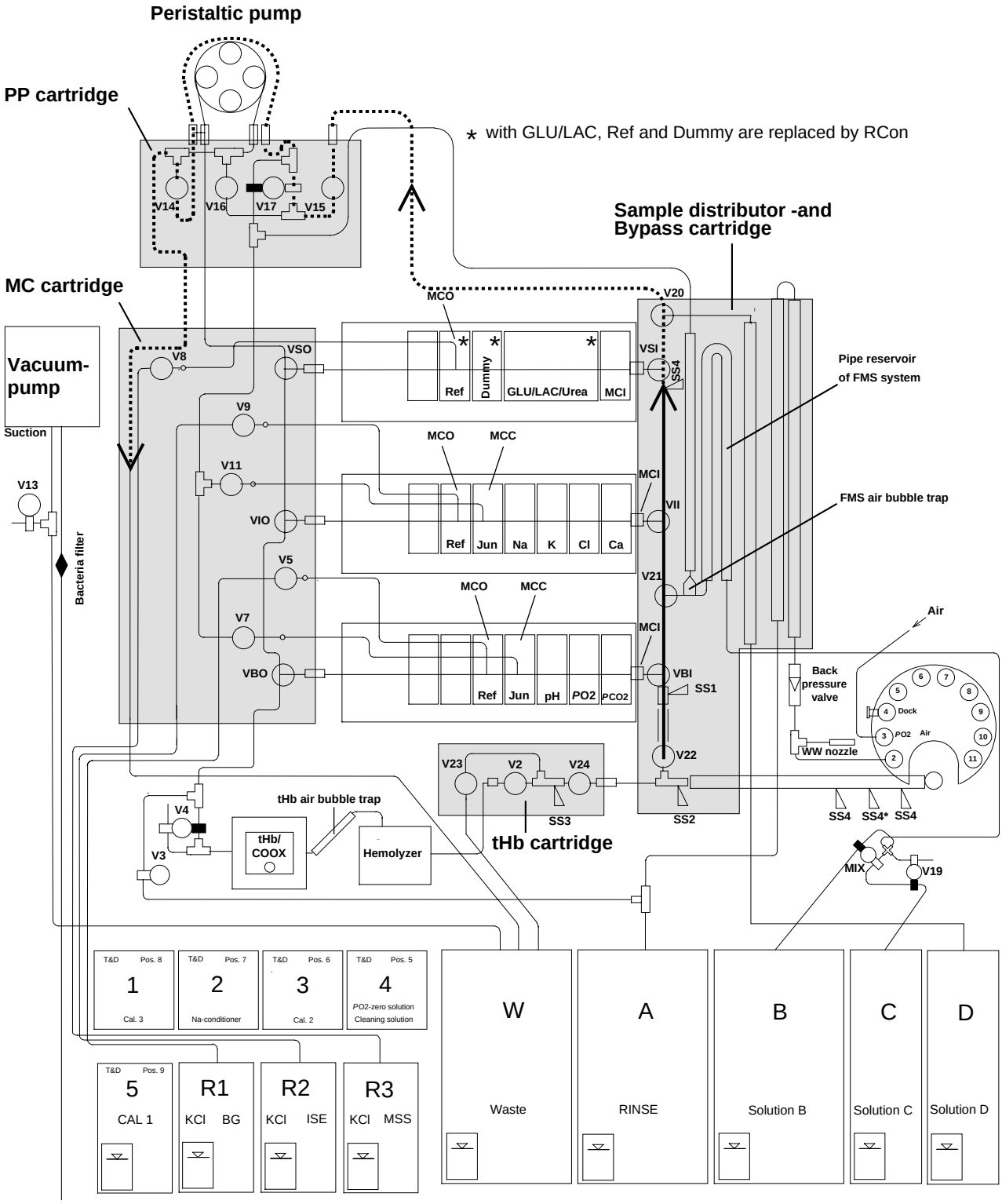
Prepare Int/1P/Slp



* SS6 at AVL OMNI 7, 8 and 9

Fig. 19: Tubing diagram 19

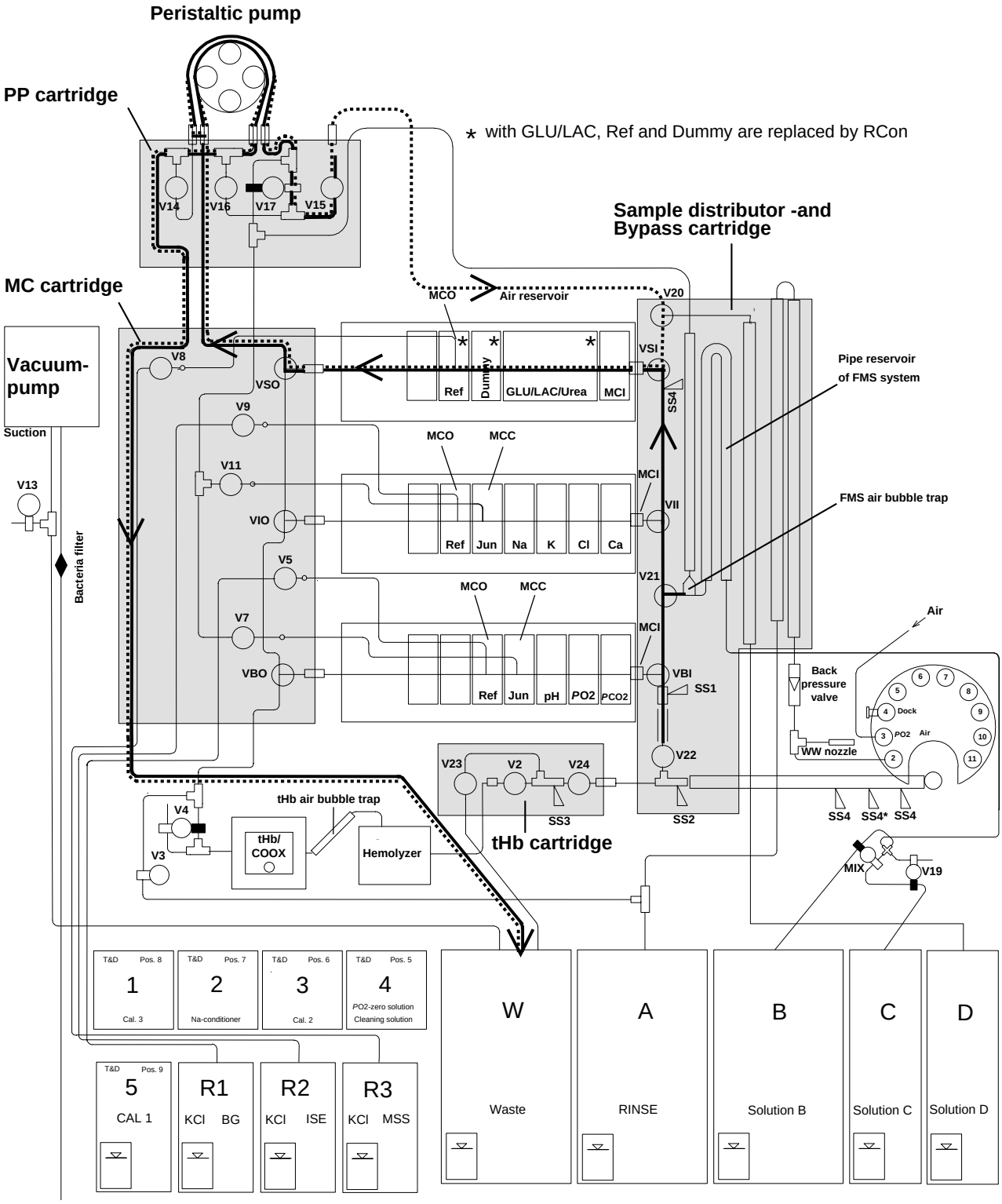
Positioning at Sample sensor SS4



* SS6 at AVL OMNI 7, 8 and 9

Fig. 20: Tubing diagram 20

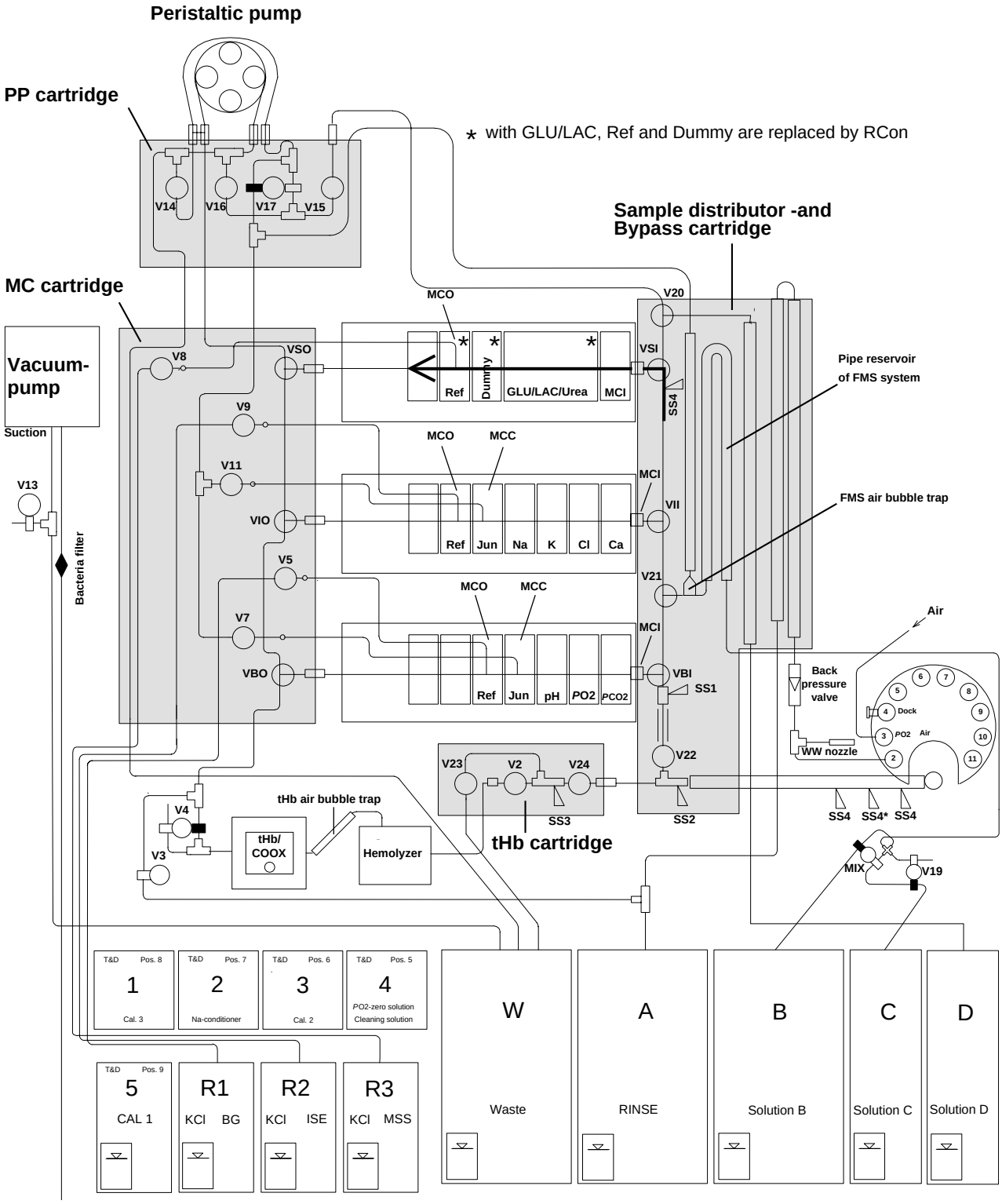
Aspirate Int/1P/Slp into the MSS measuring chamber (first phase: flush)



* SS6 at AVL OMNI 7, 8 and 9

Fig. 21: Tubing diagram 21

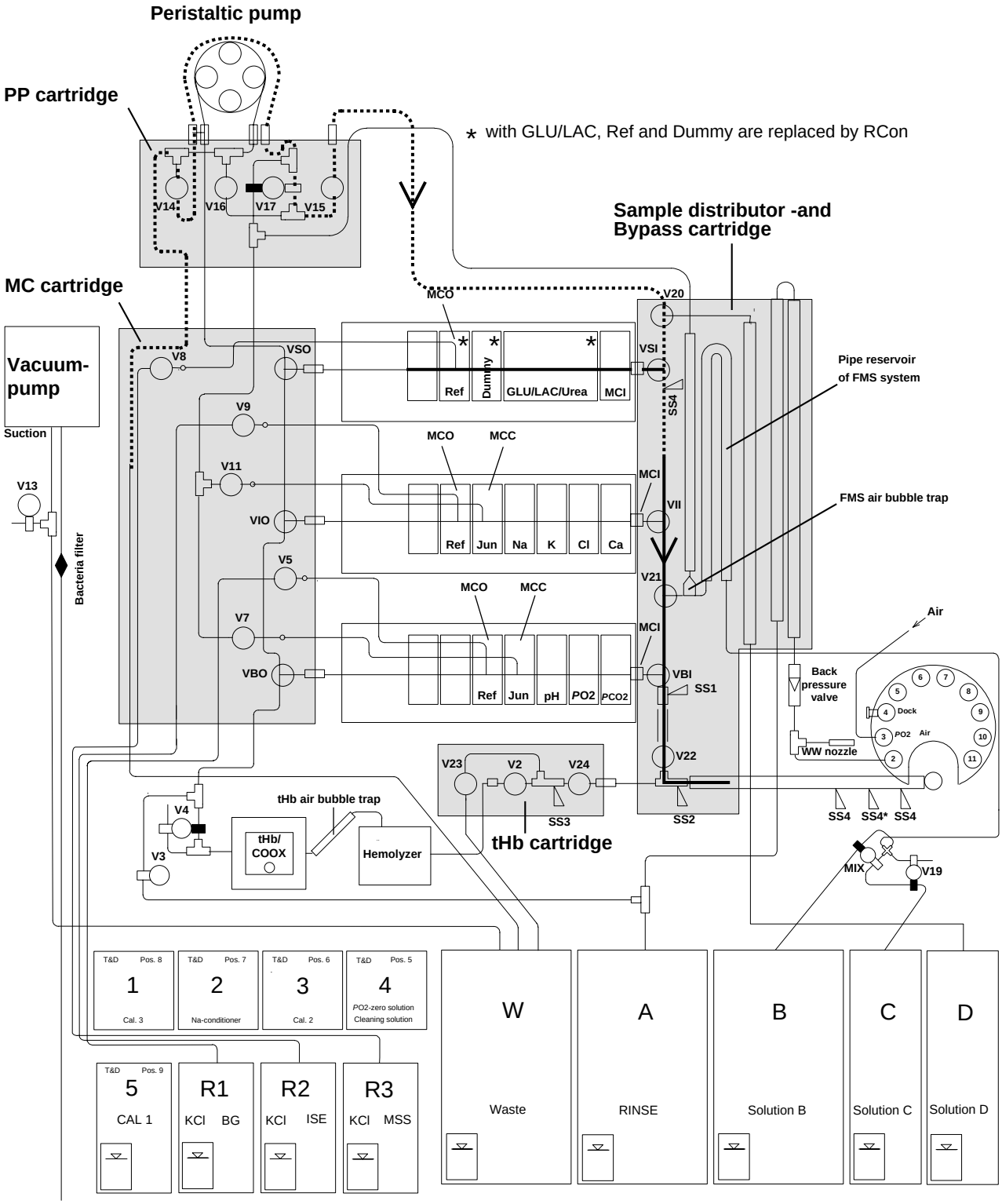
Aspirate Int/1P/Slp into the MSS measuring chamber (second phase: fill)



* SS6 at AVL OMNI 7, 8 and 9

Fig. 22: Tubing diagram 22

Push back residual solution in the sample distributor



* SS6 at AVL OMNI 7, 8 and 9

Fig. 23: Tubing diagram 23

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Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Maintenance	Δ	Δ	•, Δ	Δ	Δ	Δ	•, Δ
Software update			•		•	Δ	•
Service	Δ	•, Δ	Δ	•, Δ	Δ	Δ	Δ

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Maintenance	•, Δ						
Software update							
Service	•, Δ						

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

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8 Maintenance / Service area

Maintenance

This chapter describes the maintenance tasks which must be performed by the service technician and partially by the user, to ensure the proper functioning of the AVL OMNI™ .

S.....perform by the service technician only
C/S.....perform by the customer or service technician

NOTE: *Please refer also to Operator's Manual, chapter 9, section "Maintenance" !*

Daily maintenance

Check the fill level of the reagents	Control in the program section "**Options - Reagent Fill Levels**".	C/S
Decontamination of surfaces	Decontaminate all outside surfaces including all covers (e.g. measuring chamber covers, bottle compartment cover), as well as the outside surfaces of the AutoQC module (if available), with the disinfectant according local regulations (see also chapter 1).	C/S
Data storage	– **Data manager values:** For details, please refer to section "Software update" on page 8-7 orOperator's Manual, chapter 7, "Data Manager". – **System settings:** Press: "**System - Util - Analyzer Actions - File Actions - Export Setup**". ***NOTE:*** *Do not use in connection with software update!*	C/S

Weekly manintenance

In addition to the daily maintenance:

Check the T&D disc for dirt	Optical control. If cleaning is necessary press "**Options - Cleaning - Interrupt for Cleaning**". Cleaning method: distilled water, for example. For details, please refer to Operator's Manual, chapter 9, "Maintenance".	C/ S
Cleaning the tHb- or COOX module	For details, please refer to Operator's Manual, chapter 9, "Maintenance".	C/ S

3-monthly maintenance

In addition to the daily and weekly maintenance:

Changing the pre-filter In a clean laboratory environment and at room temperature (significantly below the maximum permissible operating temperature), the filter may be replaced less frequently.	See chapter 5.	C/ S
tHb- / COOX calibration	Press: "**System - Cal - tHb Cal**" (AVL OMNI™ 2, 5 and 8 only) or "**System - Cal - COOX Cal**" (AVL OMNI™ 3, 6 and 9 only) Please refer also to Operator's Manual, chapter 9, "Maintenance/3 Monthly/ tHb-/COOX calibration"	C/ S
Changing the PP tubing (in devices with tHb/COOX module, the functioning of the PP tubing is checked automatically).	See chapter 5.	C/ S
Check smooth movement of PP-head rollers.	Check the rollers of the PP head for smooth movement (retardation in movement indicates abnormal abrasion of PP-tubing and one-sided deformation). For replacement of PP head and PP tubing, see chapter 5.	S

Half-yearly maintenance

In addition to the daily, weekly and 3-monthly maintenance:

Changing the fluorescent lamps at devices with a serial number < 1500 and ident number EL0261.	See chapter 10 ***NOTE:*** *After the useful life of the tube expires, smoke development may occur.* *Therefore, the replacement of the fluorescent lamps should be included in the maintenance checklist under "**System - Setup - Miscellaneous - Maintenance Actions**".*	S
Replacement of tHb- or COOX cuvette	See chapter 5	S
Cleaning of MSS tubes	Activate: "**Options - Cleaning - Cleaning of MSS-Tubes**" – Connect the shutdown tubing set to the correponding suction tubes of Solution 1, 3, 5 and D (see chapter 4, section "Shutdown"). The tubes with the long rigid ends are connected to Solutions 5 and D, the tubes with the short rigid ends are connected to Solution 1 and 3. – Put the tubing harness in a container with AVL Deproteinizer. Press the key "**Continue**" and follow the instructions on the screen. – Insert new bottles in the corresponding postions to prevent contamination of the cleaned tubes and further contamination of the MSS module.	C/ S

Yearly maintenance

In addition to the daily, weekly, 3-monthly and half-yearly maintenance:

Changing the bacterial filter	See chapter 5.	C/ S
Changing the fill port	Remove the fill port resp. the fill port adapter by turning it downward.	C/ S
Changing the FMS air bubble trap	See chapter 5.	S
Changing the entire tubing system	See chapter 5.	S
Changing the vacuum pump head	See chapter 5.	S
Changing the tHb air bubble trap	See chapter 5.	S
Changing the fan filter	See chapter 5.	S
Changing the valve cartridge (SD, MC, PP, tHb- or bottle compartment (BC) cartridge)	Change with the testprogram "**System - Util - Analyzer Actions - Park Cartridges**". Please see chapter 5 for the description of the cartridge change.	C/ S
Changing the contact clip (MSS module)	See chapter 5.	C/ S
Changing the aerosol trap	See chapter 5. If there is no aerosol trap installed, the aerosol trap BP1937 should be installed between Waste container and vacuum pump.	S
Check bottle connectors	Visual check for cleanness to make sure the electrical insulation is not impaired.	K/ S
Check bottle spikes	Visual check for contamination and damage.	K/ S
Check container tubes for Solution 2 and 4	Visual check for corrosion.	K/ S
Check sensor for Waste cover T2	Visual check for damage.	K/ S

Yearly maintenance at AutoQC-module (option)

Steel tube, Wash port and thw tube at valve are parts of the AQC maintenance kit.

Changing the steel tube	See chapter 5.	C/ S
Changing the wash port	See chapter 5.	C/ S
Changing the tube at valve	See chapter 5.	C/ S
Check whether steel tube is centered in ampoule	If not, activate: "**System - Util - Service Area - AutoQC Adjustment**".	K/ S

Every 3 years Changing of accumulator (PC types **AT96** with ident number **EN0290** only).

Unscheduled

Cleaning the bottle compartment	For details, please refer to Operator's Manual, chapter 9, "Maintenance".	C/ S
Cleaning the touch screen	Cleaning with testprogram "**Options - Cleaning - Clean Display**". Caution: clean damp with 3% NaOCl solution, for example; do not use sprays.	C/ S
Checking brightness of touch screen	Visual check whether screen brightness is sufficient for local conditions. If necessary, replace the fluorescent lamp (see chapter 5).	S
Half-yearly or during an electrode change - checking the measuring chamber for dirt	Open measuring chamber cover and remove electrodes. Cleaning with NaOCl, for example; do not use sprays. Insert electrodes and close measuring chamber cover.	C/ S
Cleaning the fill level sensor for Waste	Open bottle compartment cover, remove Waste container, wipe fill level sensor dry, insert Waste container, close bottle compartment cover.	C/ S
Check the thermal printer paper supply in the printer	Optical control.	C/ S
Check the fill port for dirt	Optical control, when cleaning is necessary call up testprogram "**Options - Cleaning - Interrupt for Cleaning**". Cleaning method: damp cotton swab or a 3 % NaOCl solution, for example. For details, please refer to Operator's Manual, chapter 9, "Maintenance".	C/ S
Deproteinizing the MC cartridge	Deproteinizing with testprogram "**System - Util - Analyzer Actions - Fluid Actions - Deproteinizing MC Cartridge**". For details, please refer to Operator's Manual, chapter 9, "Maintenance".	C/ S

Cleaning the Chlorid electrode	Cleaning with deproteinizer[1] or with cleaning set (see chapter 9 under "Cl Electrode Dirty (Defect) !".	C/S
Checking the wash water nozzle	Press "**Options - Wash**" and observe the air bubbles. For details, please refer to Operator's Manual, chapter 9, "Maintenance".	C/S

[1] This type of cleaning procedure using AVL Deproteinizer (e.g.: Na-Hypochlorite) and/or Neodisher is to be performed as rarely as possible, since it basically disturbs the measuring system. It is expected that this cleaning procedure will depend on the typical sample type of a laboratory (e.g.: physiological, pathological, fetal blood) and will be performed after 100 - 1000 samples.

Software update

Update of the entire software

NOTE: *Note customer settings befor you start with modifications. You will find more important settings under "**Options - Reports - Status Report**"*

1. Switch off the AVL OMNI™ and on again.
2. Wait approx. 30 seconds and then insert installation disk **1** into the floppy drive.
3. Insert the remaining installation disks as prompted on the screen. The AVL OMNI™ goes automatically into the "**Ready**" - status.
4. Restore all settings.

Update of the T&D software

See chapter 5 ("Function modules from A - Z") under "T&D system - Software - Software Update".

Service area

The program function "**Service Area**" is only accessible for AVL-schooled service persons, and is secured with a password.
In the following, a description of the possible settings in this menu can be found.

Switches 1

Avopto Save On/Off

This function can be used to setup an Avopto report. This takes place on the hard disk under the data name AVOPTO.TXT.
This file uses a lot of memory capacity and should therefore be compressed regularly under "**System - Util - Analyser Actions - File Actions - Service Archive - Archive AVOPTO**" (approx. every second or third day).
Export the Avopto approx. every 3 to 6 days under "**System - Util - Analyser Actions - File Actions - Service Archive - Export AVOPTO**", so that the file does not exeed the memory capacity of the disk.

NOTE: *If this function is used frequently, check the remaining memory capacity on the hard disk regularly.*

Cal Sim On/Off

This function brings the analyzer back to the "**Ready**" status after a minimum of aspiration cycles. The calibration values are simulated.
You have the possibilty to observe single calibration procedures by activating a calibration after turning on the Cal Sim.

NOTE: *Do not forget to deactivate this function after service. Otherwise, the AVL OMNI™ provides improper measurement values.*

Avopto Report On/Off

This function enables the printout of the Avopto report on the thermal printer.

Backfeed On/Off

With this function, the printer paper is automatically drawn in before a new printout is started.
This permits consecutive printouts without interruption.

NOTE: *In thermal printers with revision number 1.1 and 1.2, this function should not be is "**ON**".*

Apply COOX Corrections
(AVL OMNI™ 3, 6 and 9 only)

With this function the internal measurement value monitoring function and the corrective function can be turned off briefly. The default setting is "**ON**".
"**ON**" is also automatically set after each power on and once a day.

NOTE: *Do not forget to deactivate this function after service. Otherwise, the AVL OMNI™ provides improper measurement values.*

Luminations On/Off

This function enables a turning on and off of the permanent measuring chamber lighting.

NOTE: *Turn off the permanent measuring chamber lighting after repair work has been done. When the lighting is turned on permanently its lifetime is minimized greatly.*

Service Keyboard On/Off

With this function the keyboard special functions can be locked or released.

MSS-Temp. increased
(AVL OMNI™ 7, 8 and 9)

With this function, the MSS measuring chamber operating temperature can be changed from 25 °C to 30 °C.
If the function is "**ON**" (30 °C), operation in an environment with 95% humidity is possible.

NOTE: *When the MSS measuring chamber temperature is set to 30 °C the lifetime of the lactate sensor will be reduced.*

Economy Mode On/Off

If the AVL OMNI™ is not used for a prolonged period of time, it can be put into the standby mode.
In this mode, reagent consumption is reduced, the electrodes are, however optimal conditioned through a system maitenance process. This process occurs every 3 hours, lasts approx. 2.5 minutes and cannot be interrupted.
After activating the standby mode in the service area, you can select automatic or manual standby mode activation.

- Automatic standby mode:
  Activate program "**System - Setup - Miscellaneous - Times and Intervals - Economy Mode**".
  You can activate the standby mode for hourly or daily periods.
- Manual standby mode:
  Activate program "**Options - Economy Mode**".
  Exit by pressing the "**Manual EXIT**" key.

Timer 1 and **Timer 2** can be activated simultaneously.

After exiting the standby mode, the next calibration due is performed.

AutoQC On/Off

This function can be used to activate and deactivate the AutoQC module (option).

Hct On/Off

This function can be used to deactivate the hematocrit value.

NOTE: *After the Hct is reactivated, it is necessary to turn the AVL OMNI™ off and back on again !*

AQC Temp. Correlation

If the switch is "**On**", the ampoule ambient temperature is measured by the temperature sensor located inside the AutoQC module.
The value is used for correction of QC measurement values (PO_2 and $_PCO2$ only).
The calculated ampoule temperature is indicated on the QC report.
The measured data is transferred digitally to the AQC control board.
Only AutoQC values are being corrected, not values from manual QC measurements.
The measured value and the status of the temperature sensor can be read under "**System - Test - Component Test - Aggregates - AutoQC - Temp. Sensor**".

Setup

BP Set

The barometer sensor is set with this function. This slope value is labeled on the barometer sensor located on the Mainboard (see chapter 5, "Mainboard - Components location"). The value must be re-entered after replacement of the board.
Simultaneously, the actual absolute barometric pressure is to be given in (not the sea level reduced barometric pressure), which is measured with an external barometer.
Factory delivery includes default settings for both values, slope and actual absolute barometric pressure.

O2-UPol

The polarization voltage of the PO_2-Electrode is set with this function. To do this use the test device for BG measuring chamber BP2244.
This setting is necessary when the BG measuring chamber or the Connector board is changed.

Sample Counter

The sample counter registers every measurement. The service technician can read off or turn back the sample count with this function.

Reset Cal. Values

The activation of this function resets all calibration values.

Show Versions

The activation of this function gives information over the serial number, AQC version and the current program versions from SW, PC, MC, MM, TD, as well as PX and CCD (AVL OMNI™ 3, 6 and 9 only).

Hotline Number

The activation of this function enables the input of the respective hotline number.

Reset MSS Cal. (AVL OMNI™ 7, 8 and 9 only)

The activation of this function resets all MSS calibration values.

Set Serial Number

The activation of this function enables the input of the serial number.

Delete Data

This menu allows to delete selected databases in the data manager (patient-, calibration and maintenance databases or all databases as well as the AVOPTO-files).

> ***ATTENTION !*** *The activation of this function deletes all data bases irrevocable.*

Reset MSS Cal. (AVL OMNI™ 7, 8 and 9 only)

The activation of this function resets all MSS calibration values.

Special Tests

Optobus

With the help of this function analyzer errors are shown. Displayed errors indicate an error in the hardware. Possible errors could be the light gates from the optobus or a module error (see also chapter “Troubleshooting”, section “Service report - Report structure”).

Interpretation:

"**Lost messages**"

Number of lost messages; a module attempt without success to transmit a message (3 attempts max.).

Consequences:	May cause system error, depending on message content.
Permissible limit:	< 1 per week during continuous operation
Remedy:	Replace one or more boards connected to the Optobus (Mainboard, T&D control, PolyOX-KX-control 9700 LY3, AQC control board).

"**HW instabilities**"

Counts how often the bus was into an invalid state in standby.

Consequences:	This state of the bus usually causes neither a transmission error nor a significant time loss (<100µs).
Permissible limit:	< 100 per day
Cause:	Hardware problems (increased interference susceptability of the opto modules or interference in the device)
Remedy:	Replace one or more boards connected to the Optobus (Mainboard, T&D control, PolyOX-KX-control 9700 LY3, AQC control board).

"**Reinitializing**"

Counts how often the bus had to be reinitialized. The bus is put into a defined state, all message numbers etc. are synchronized and a special message is sent from the main control to each module (AutoQC module, T&D module, COOX module) to check correct response.

Consequences:	Approx. 30ms during which no message can be transmitted. If this happens at an inconvenient time, a certain process may be interrupted and a system error may occur.
Permissible limit:	< 20 per day
Remedy:	Replace one or more boards connected to the Optobus (Mainboard, T&D control, PolyOX-KX-control 9700 LY3, AQC control board).

"**Solved failures**"

Sum of all other problems such as transmission errors, timeouts, etc. which were, however, eliminated during repeat attempts.

Consequences:	None, but it increases the probability of unsuccessful message transmission even in 3 attempts.
Permissible limit:	< 100 per day
Remedy:	Replace one or more boards connected to the Optobus (Mainboard, T&D control, PolyOX-KX-control 9700 LY3, AQC control board).

Switches 2

New Cleaning Sol. On/Off

Activating this function enables an automatic cleaning routine with Solution 6.

NOTE: *If this function is "**OFF**", cleaning with Solution 4 is no longer performed. In this case an external cleaning with AVL De-proteinizer is required.*

COOX Module (AVL OMNI™ 3, 6 and 9)

Optics Test

This function permits to monitor the performance of the optical components of the COOX module. The module has either the software version **3.001** or **3.004**. Please check the version, before you continue with the test described bellow.

Displayed values:

x: position of the brightest value of the imaged spectrum on the CCD.

y: intensity of the brightest value at position x.

Values when polychromator is calibrated (ti Halo > 12 ms):

Lamps	**x**	**y**
Off	not relevant	not relevant
Halo On	not relevant	not relevant
(SV 3.001) Neon On	252 - 256	5.000 - 15.000
(SV 3.004) Neon On	252 - 256	5.000 - 200.000

Scan: number of oversamplings
When leaving the menu the value 16 **(SV 3.001)** or 8 **(SV 3.004)** is reset automatically.

ti halo: integration time (exposure time) of the CCD in milliseconds after polychromator calibration (20 – 110; typ. < 60 with **SV 3.001** and 40 – 200; typ. < 120 with **SV 3.004**).

ti neon: integration times of neon spectral lines used for wavelength calibration.

(SV 3.001) ti neon (1): < 350
(SV 3.004) ti neon (1): < 630

Edit Scan/ Edit ti Halo for testing at AVL only

NOTE: *An accidental change in "**ti Halo**" requires a manual call up of a wavelength calibration.*

If the recommended intensity values can not be reached with the lamp switched on, there may be an interruption of the light path or a contamination of the cuvette (Error elimination see chapter 9, "COOX: No Sample Detected").

Wavelength Cal.

(= polychromator calibration)
A wavelength calibration must be performed after exchanging any component in the optical path (light guide, cuvette, etc.) or if an accidental change in "**ti Halo**" has been made. It is also performed during system calibration.

Offset

This function sets the %-offset of Hb-derivatives.

NOTE: *These values are preset and must not be changed !*

Interference Control On/Off

With this function (default: "**On**"), the blood sample (human blood) is automatically checked for interfering substances. If interferences are detected, no measurement value is issued and the message "**Interferences**" appears on the screen and on the measurement report.
If the customer nevertheless wishes measurement values, the switch can be turned "**Off**".

Turbidity Corr. On/Off

The default setting of this function is "**Off**".
When this function is turned "**On**", the COOX measurement results will be corrected.

Special Shutdown

If a shutdown procedure was performed on the AVL OMNI™ and it is necessary to turn the analyzer on again for a short period of time, you can use this function to circumvent another shutdown procedure.
Follow the instructions the screen !

AutoQC (Option)

This button appears only if activated under "System - Util -Service Area - Switches 1 - AutoQC".

Serial Number Mechanics

If the AQC control board is replaced, the serial number must be set in accordance with the label attached to the AutoQC module.

Revision Number Mechanics

If the AQC control board is replaced, the revision number must be set in accordance with the label attached to the AutoQC module.

Total Measurements

The values shown in this picture provide information on the number of measurements performed with the AutoQC module.
If this number is to be retained after installation of a new AQC control board, the number must be entered accordingly.

AutoQC Adjustment (Option)

This function is used for position adjustment in X- and Y-direction so that after replacement of the AQC control board and/or the ampoule holder the ampoules are pierced at the right spot.

Activate/Deactivate Urea

(AVL OMNI™ 7, 8 and 9 only)

With this function, the urea parameter can be activated or deactivated.

NOTE: *This routine does not include deproteinizing, washing- or drying cycle and may thus destroy the MSS cassette. Therefore it should only be used during a first startup.*

List of modifications, chapter 9 (Troubleshooting)

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**2.0, Dec. 95/ SN 1146**	**3.0, March 96/ SN 1500**	**4.0, July 96/ SR ≥2.0**	**5.0, Jan. 97/ SR ≥3.0**	**6.0, Aug. 97/ SR ≥4.0**	**7.0, May 98/ SR ≥4.5**	**8.0, Nov. 98/ SN 5000 SR ≥5.0**
Errors identified by the software	Δ		•, Δ	Δ	•, Δ	Δ	•, Δ
Error functions not identified by the software			Δ	Δ	Δ	Δ	•, Δ
Appendix		•					
Service report			Δ	Δ	•, Δ	•, Δ	•, Δ

Manual revision/ applicable from serial number (SN) or software revision number (SR)	**9.0, May 00/ SR ≥5.50**						
Errors identified by the software	•						
Error functions not identified by the software	•, Δ						
Appendix							
Service report	•, Δ						

• Modification (previous states of revision see chapter 10, "Previous revision levels")

Δ New or addition !

9 TROUBLESHOOTING

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9 Troubleshooting

NOTE: *Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.*

The following errors can occur on the AVL OMNI™.

Errors identified by the software:

- **System stops** -
  Displayed in the message window (Header, right above) and in the system stop window.
- **System warnings** -
  Displayed only in the message window
  (no stopping of the system).
- Errors with displayed in the **Electrode status report**
  (no stopping of the system).

Errors not identified by the software:

- **Other problems which may be encountered.**

Errors identified by the software

System stops

Displayed in the message window (Header, right above) and in the system stop window.

Close Bottle
Compartment Cover !

Is the bottle compartment cover open?

no **yes**

↓ Close bottle compartment cover.

Switch of bottle compartment cover defective.

Date Invalid!
Please Set Date/Time!

The date is less than 1.1.1999 ⇒ Set date/time under "**System – Setup – Miscellaneous – Times & Intervals**".

Communication error + additional information

Observe LED 2, 3 and 4 of the Main control (see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard"). Normally, the three LED's should glimmer with the same intensity.

Do all 3 LED's glimmer with the same intensity? Is the Communication error number 1, 2, 3 or 4?

no . **yes**

One or more modules do not respond ⇒ change defective module (change see chapter 5).

The following applies:

Measurement control module..... **Communication error 1**

COOX module..... **Communication error 2**

AutoQC module (option)..... **Communication error 3**

T&D module ..... **Communication error 4**

Do the 3 LED's glimmer with uneven intensities? Communication error 255?

- Check Optobus for interruption.
- Check supply of modules.
- Check DIL switch position on the Mainboard (see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").
- Determine defective module by successively removing all modules from the Optobus and reconnecting the optical light guides until all LED's emit an evenly bright light.
- Change defective module (change see chapter 5).

Fill Error

Is a reagent bottle empty, or the Waste container full?
Note that if Solution B (C) is empty, Solution C (B) is automatically set to empty.

no . **yes**

Change the bottle as described.

Is one of the fill level sensors dirty?

no . **yes**

Clean fill level sensor.

Waste container:

Clean the lightgate coupling and the fill level sensor on the red Waste cap T2.

Fill sensor error + additional information

Each fill sensor error is accompanied by a number. The number identifies which bottle sensor should be checked (see Fig. 1):

Interpretation:

- **Fill sensor error (Bottle number + 20):**
  The difference between illumination value and dark value is less than -50mV, indicating a defective Mainboard or Fluid level detector board.
  The display in the test program "**System - Test - Component Test - Sensors - Fill Levels Sensors**" is l mV for Waste and 5396 mV for all other bottles.
- **Fill sensor error (Bottle number):**
  The dark value is greater then 4000 mV, indicating an external light source or a defective Fluid level detector board or Mainboard.
  The display in the test program "**System - Test - Component Test - Sensors - Fill Levels Sensors**" is 0 mV for waste and 5000 mV for all other bottles.

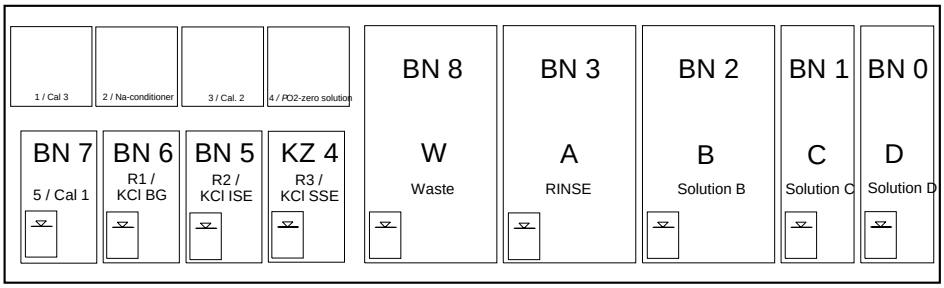


Fig. 1: Bottle number

Is the bottle compartment exposed to excessive direct sunlight or bright ambient light?

no . **yes**

Reduce excess light exposure to the AVL OMNI™.

- Hardware defective on Fluid level detector board ⇒ change board (change see chapter 5).
- Mainboard defective ⇒ change Mainboard (change see chapter 5).

Fill level sensor soiled?

no . **yes**

Clean fill level sensor.

Cable of optical light guide damaged? Connector to FLD board loose/damaged?

no . **yes**

Change fill level sensor (change see chapter 5).

Fill level sensor damaged mechanically?

no . **yes**

Change fill level sensor (change see chapter 5).

FMS error

The following scenarios are built up in a logical way and are to be performed successively until the error source has been identified.

Scenario 1:

Call up "**System - Util - Analyzer Actions - Fluid Actions - Fill Routines - Aspirate Sol. B**" repeatedly and several times. Confirm that Solution B is aspirated. Check the packages of fluid in the tubing connection FMS/SD pipe.
Normally, when the FMS switches to air at the end of the aspiration process, no bounce of the liquid column is observed.

Do you see a bouncing movement of the liquid column towards the bottle at the end of the aspiration process?

no

yes

Bottle B has under-pressure since the tube, which ventilates bottle B, is not open.

- Bottle not properly inserted.
- Spike to open bottle is damaged.
- Air tube is clogged.

The container pipes has not completely penetrated the bottle plug:

- Bottle is not properly inserted.
- Aspiration pipe has been pushed back into the analyzer.
- Rests of foil from the stopper are blocking the container pipe.

The fluid packages are aspirated well. They do not speed up at the end of the aspiration process.

⇒ **Scenario 2**.

Scenario 2:

Call up "**System - Util – Analyzer Actions - Fluid Actions - Fill Routines - Aspirate Sol. C**" repeatedly and several times. Confirm that Solution C is aspirated. Check the packages of fluid in the tubing connection FMS/SD pipe.
Normally, when the FMS switches to air at the end of the aspiration process, no bounce of the liquid column is observed.

Do you see a bouncing movement of the liquid column towards the bottle at the end of the aspiration process?

no

yes

Bottle C has under-pressure since the tube, which ventilates bottle C, is not open.

- Bottle not properly inserted.
- Spike to open bottle is damaged.
- Air tube is clogged.

The container pipe has not completely penetrated the bottle plug:

- Bottle is not properly inserted.
- Container pipe has been pushed back into the analyzer.

The fluid packages are aspirated well. They do not speed up at the end of the aspiration process.

⇒ **Scenario 3**.

Scenario 3:

Call up "**System - Setup - Edit Reports - Service Report**" and switch "**FMS Parameter**" on.
Call up a 1P calibration and read the lines "%CBG and %CISE" on the printout. Typical value: 33% +/- 2%.

Value > 41.30?

no **yes**

The percentage of Solution C in Mix 1 is too high (or Solution B is too low) ⇒ **Scenario 4**.

Value < 25.30.

The percentage of Solution C in Mix 1 is too low ⇒ **Scenario 6**.

Scenario 4:

Call up "**System - Setup - Edit Reports - Service Report**" and switch "**FMS Parameter**" on. Call up 1P calibration and read the line "%Mix" on the printout. Typical value: 33% +/- 2%.

Value > 27.00?

no **yes**

An automatic regulation of the mixing ratio is still possible. Re-insert bottle B/C (read barcode) and call up further calibration.

Value = 27.00.

Further regulation of the mixing ratio is not possible. The regulation range has been utilized ⇒ **Scenario 5**.

Scenario 5:

Remove bottle B and check air ventilating connection.

Is the ventilation hole correctly punctured?

no **yes**

- Bottle has slipped out a little bit.
- Air tube is clogged.
- Container pipe has been pushed back into the analyzer.
- Check the Mix valve and related tubings.

The air ventilating connection is not punctured.

- Re-insert Bottle B correctly.
- Spike to open bottle is damaged.

Scenario 6:

Call up 1P calibration and read the line "%Mix" on the service printout “FMS Parameter”.
Typical value 33% +/- 2%.

Value < 39.00?

no . **yes**

An automatic regulation of the mixing ratio is still possible. Re-insert B/C bottle (read barcode) and call up further calibration.

Value = 39.00?

Further regulation of the mixing ratio is not possible. The regulation range has been utilized ⇒ **Scenario 7**.

Scenario 7:

Remove bottle C and check air ventilating connection.

Is the ventilation hole correctly punctured?

no . **yes**

- Bottle has slipped out a little bit.
- Air tube is clogged.
- Container pipe has been pushed back into the analyzer.
- Check the Mix valve and related tubings.

The air ventilating connection is not punctured.

- Re-insert Bottle C correctly.
- Spike to open bottle is damaged.

FMS Volume error + additional information (tn)

If an FMS volume error is signaled, the cause of the error can be detected with the aid of the automatic test procedure.

Scenario 1:

Troubleshooting comprises several individual diagnostic cycles which can activated under "**System - Util - Troubleshooting - FMS Volume Error**". During the diagnostics of the FMS volume error, the following components are tested by the main control:

- aspiration path FMS - sample distributor
- FMS ventilation
- BG measuring chamber
- Converting line
- PP cartridge valve 17

More detailed information on possible causes and remedies can be displayed upon completion of the test procedure by pressing the "**More Details**" key. Follow the instructions on the screen!

The FMS time (tn) (see also page 9-109) indicated with an FMS volume error provides information on the cause of the error.
Before each calibration of the FMS, solution B is aspirated and the time until the sample closes the contact path in the BG measuring chamber is measured. From this time the FMS time (tn) is calculated.
If this time is too long or too short a FMS volume error occurs.

Possible causes for a tn < -0.30 (sample enters measuring chamber too soon):

- peristaltic pump too fast
- Air tubing at V19 is blocked.
- fluid volume is changed by valve malfunction (e.g. V3)
- Tubings used in the FMS path are not original. (i.e. of wrong dimensions)

Possible causes for a tn > 1.70 (sample enters measuring chamber too late):

- peristaltic pump too slow
- leakage or clog
- Rinse solution (Solution A) used instead of Solution B

If the error cannot be located with the aid of the automatic test procedure, please continue with the steps described below.

The following scenarios are built up logically and are to be performed successively until the error source has been identified.

Scenario 2:

Call up "**System - Util - Analyzer Actions - Fluid Actions - Fill Routines - Aspirate Sol B**" repeatedly and check for the fluid packages on the FMS air bubble trap.
Normally, the aspirated fluid packages are separated by large air packages.

Are the fluid packages separated by large air packages?

yes

no

- FMS ventilation is incrusted.
- V19 defective (change see chapter 5).

The aspirated fluid packages contain small air bubbles?

no

yes

- Tube connection between FMS metal pipe and FMS SD pipe leaky.
- Slight leakage at FMS air bubble trap.
- Slight leakage of V19 when the air tube is pinched.

Is the aspiration of the fluid packages OK?

yes

no

- Bottle not properly inserted.
- FMS ventilation leaky (V19).
- Check position of blue coupling piece on MC cartridge and tube holder of peristaltic pump.
- PP tubing defective.
- V17 defective (change see chapter 5)
- FMS air bubble trap open or defective (change see chapter 8, under "Maintenance").

Packages of fluid are aspirated separated by large air packages, as normal.

⇒ **Scenario 3**.

Scenario 3:

Call up "**System - Util - Analyzer Actions - Fluid Actions - Fill Routines - Fill Reference Electrode**" and check BG measuring chamber exit.

Is the BG reference solution aspirated?

yes

no

⇒ **Scenario 4**.

Normal aspiration of BG Reference solution.

Function between BG Ref to peristaltic pump is OK ⇒ **Scenario 6**.

Scenario 4: (to check V14 & V4)

Call up "**System - Test - Component Test - Valve Test**" and open V14 and V3. Connect a syringe on the tube coming from the MC cartridge to the Waste container and pull to cause under pressure.
Normally, Solution A should be seen aspirating via V3 and the MC cartridge.

Is Solution A aspirated?

yes

no

- PP tubing defective (change see chapter 5).
- PP tubing connection to PP cartridge looses.
- Tube connector at the top of MC cartridge leaking.
- Leakage inside MC cartridge.
- V4 leaking.

Close V14 and create suction with syringe again. Does Solution A (under-pressure) stay in the tubings?

yes

no

V14 leaking.

Error located in the BG measuring chamber area ⇒ **Scenario 5**.

Scenario 5:

Check function of the BG measuring chamber:
Disconnect the tube from the FMS pipe on the upper SD end and insert syringe. Call up "**System - Test - Component Test - Valve Test**". Open V5 & V7 and aspirate vigorously with the syringe.

Is the Reference solution aspirated?

yes

no

Major leakage:

- MC electrode holder is not fixed correctly in place.
- An electrode is not seated properly.

Only a mix with air bubbles are aspirated from the measuring chamber, over the Junction line.

no

yes

Leakage:

- Ref. connector is leaky.
- Junction connector is leaky.
- One of the BG electrodes is leaky.
- One of the electrode seals is dirty (change the seal, or replace the electrode).

Reference solution is aspirated as required over the desired path.

Measuring chamber is blocked:

- VBO clogged.
- VBO leaky (outside of VBO, converting line).
- Obstruction in the MC electrode holder.

Scenario 6: (to check V15)

Call up "**System - Test - Component Test - Valve Test**". Open V16; disconnect tube from nipple on the SD cartridge and insert syringe. Check sealing of the V15 by aspirating with the syringe.

Built-up underpressure remains?

no ↓ **yes**

Sealing is all right ⇒ **Scenario 7**.

Built-up underpressure diminishes.

Sealing not OK:

- V15 defective (change see chapter 5).
- PP cartridge defective (change see chapter 5).

Scenario 7:

Close V16 & open V15, disconnect tube from FMS pipe on the upper SD end and connect a syringe.
To check the function of V17 switch V17 and check the underpressure sealing in both positions.

Leakage detected?

no ↓ **yes**

- V17 defective (change see chapter 5)
- PP cartridge defective (change see chapter 5)

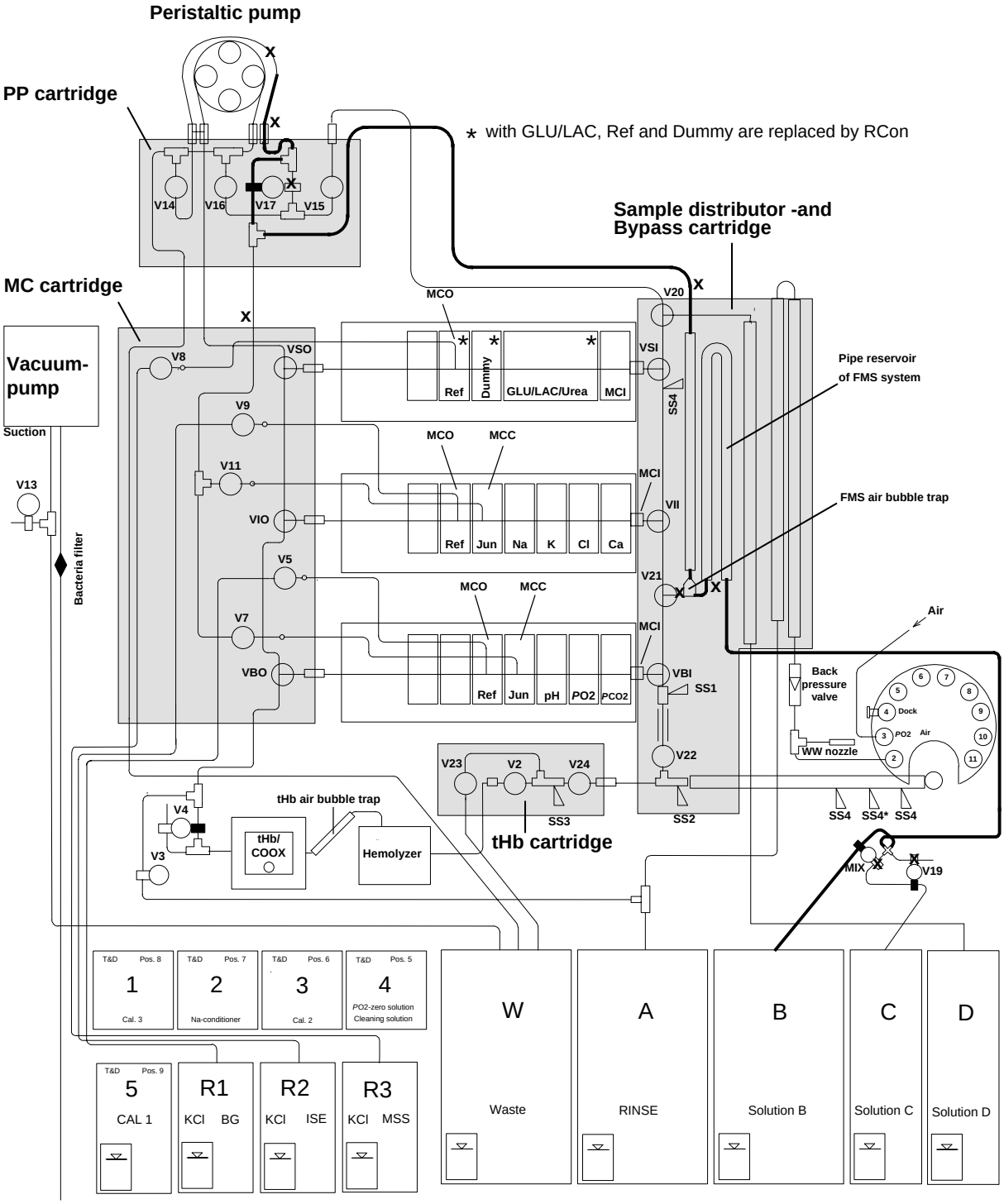
Other possible problem locations:

- SD cartridge defective (change see chapter 5).
- BG electrodes obstructed.
- V25 (VBI) or V21 clogged.

FMS volume error - errors of scenario 2

——— defective path

X critical point


Peristaltic pump
PP cartridge
* with GLU/LAC, Ref and Dummy are replaced by RCon
Sample distributor -and Bypass cartridge
MC cartridge
Vacuum-pump
Suction
Bacteria filter
Pipe reservoir of FMS system
FMS air bubble trap
Air
Back pressure valve
WW nozzle
tHb air bubble trap
tHb/ COOX
Hemolyzer
tHb cartridge
MIX
V1 V2 V3 V4 V5 V7 V8 V9 V10 V11 V13 V14 V15 V16 V17 V19 V20 V21 V22 V23 V24
VSO VSI VII VBO VBI
MCO MCC MCI
Ref Dummy GLU/LAC/Urea Jun Na K Cl Ca pH PO2 PCO2
SS1 SS2 SS3 SS4 SS4*
T&D Pos. 8 1 Cal. 3
T&D Pos. 7 2 Na-conditioner
T&D Pos. 6 3 Cal. 2
T&D Pos. 5 4 PO2-zero solution Cleaning solution
T&D Pos. 9 5 CAL 1
R1 KCl BG
R2 KCl ISE
R3 KCl MSS
W Waste
A RINSE
B Solution B
C Solution C
D Solution D

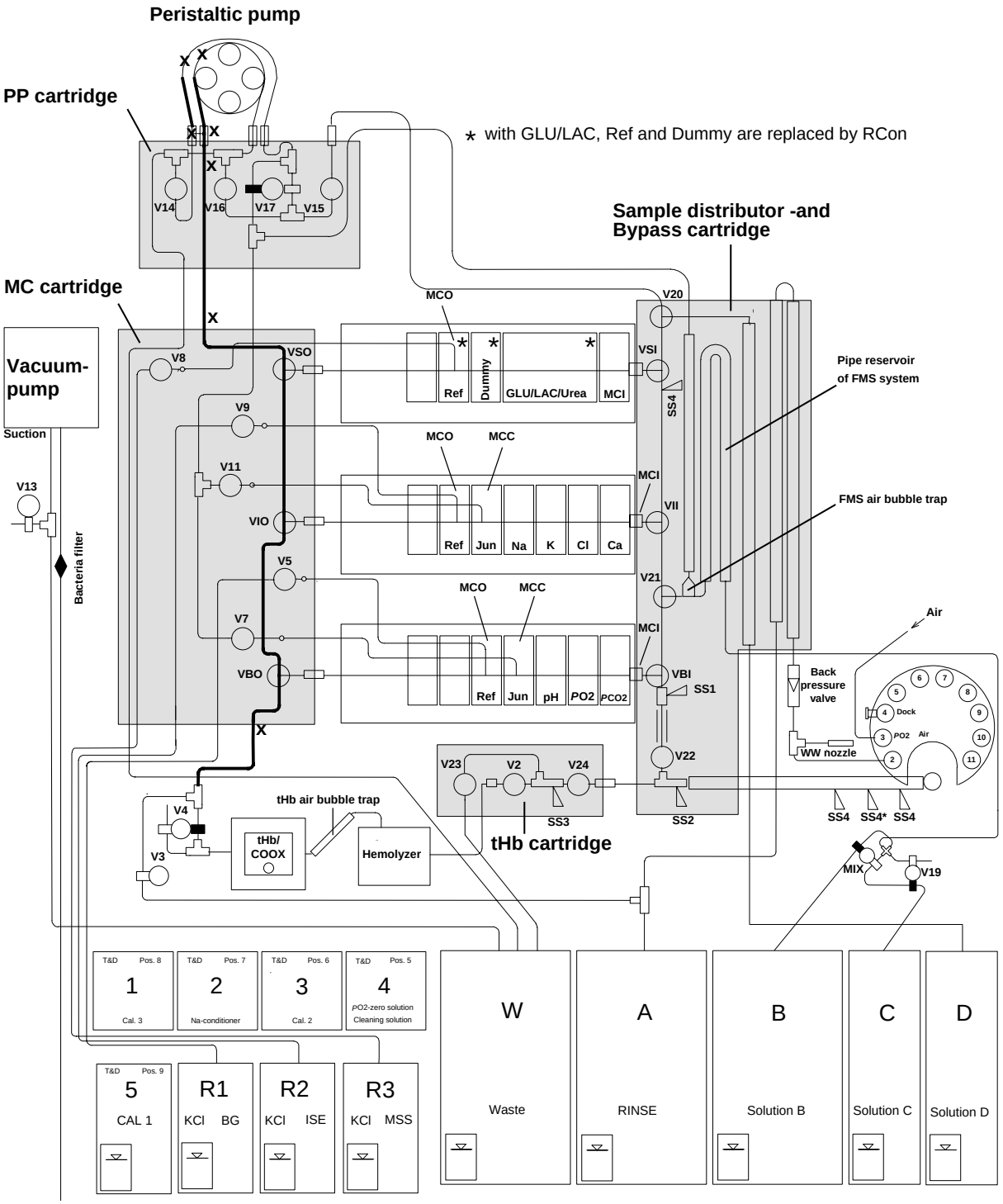
* SS6 at AVL OMNI 7, 8 and 9

Fig. 2: FMS volume error - errors of scenario 1

FMS volume error - errors of scenario 4

——— defective path

X critical point



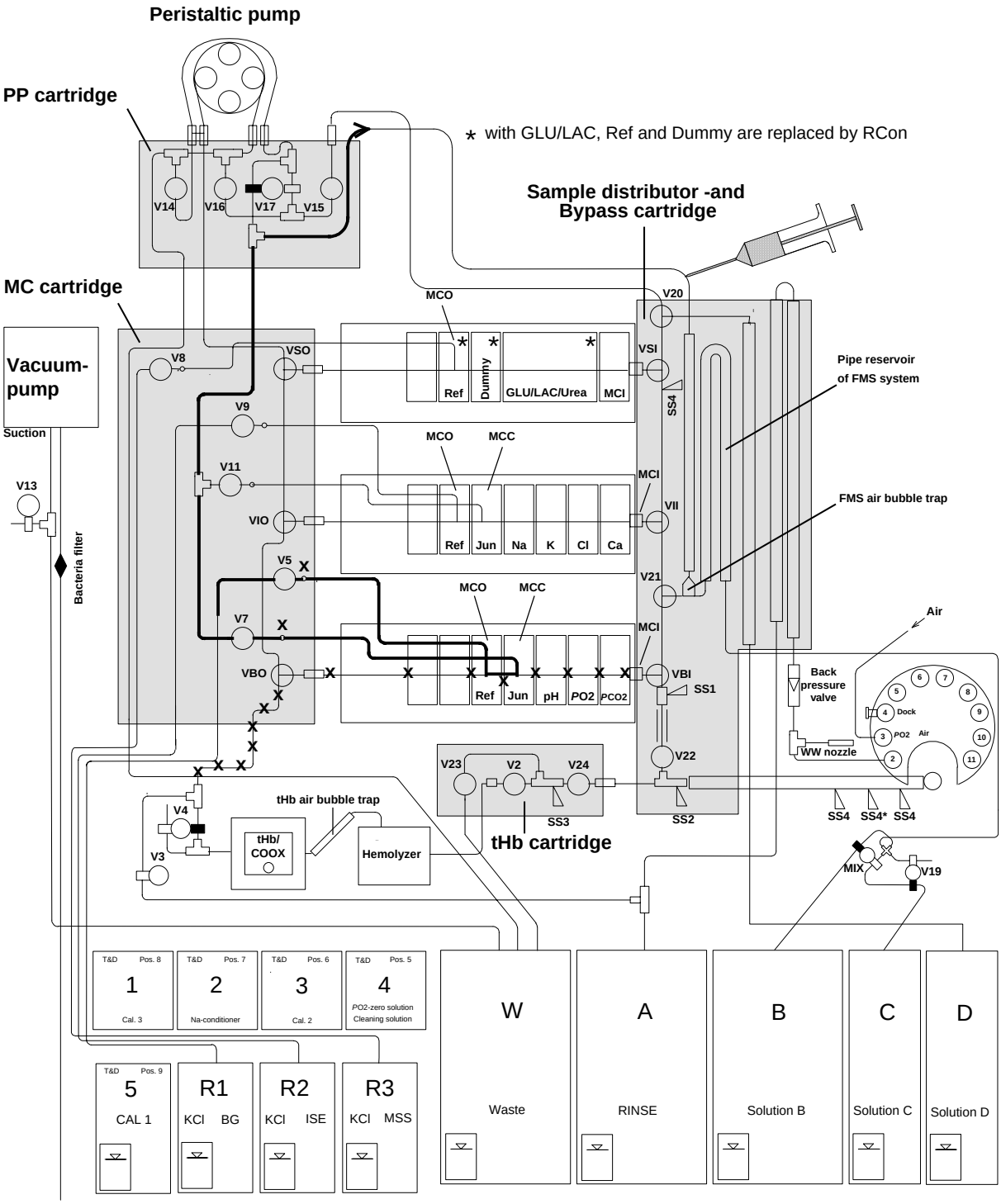
* SS6 at AVL OMNI 7, 8 and 9

Fig. 3: FMS volume error - errors of scenario 3

FMS volume error - errors of scenario 5

——— defective path

X critical point

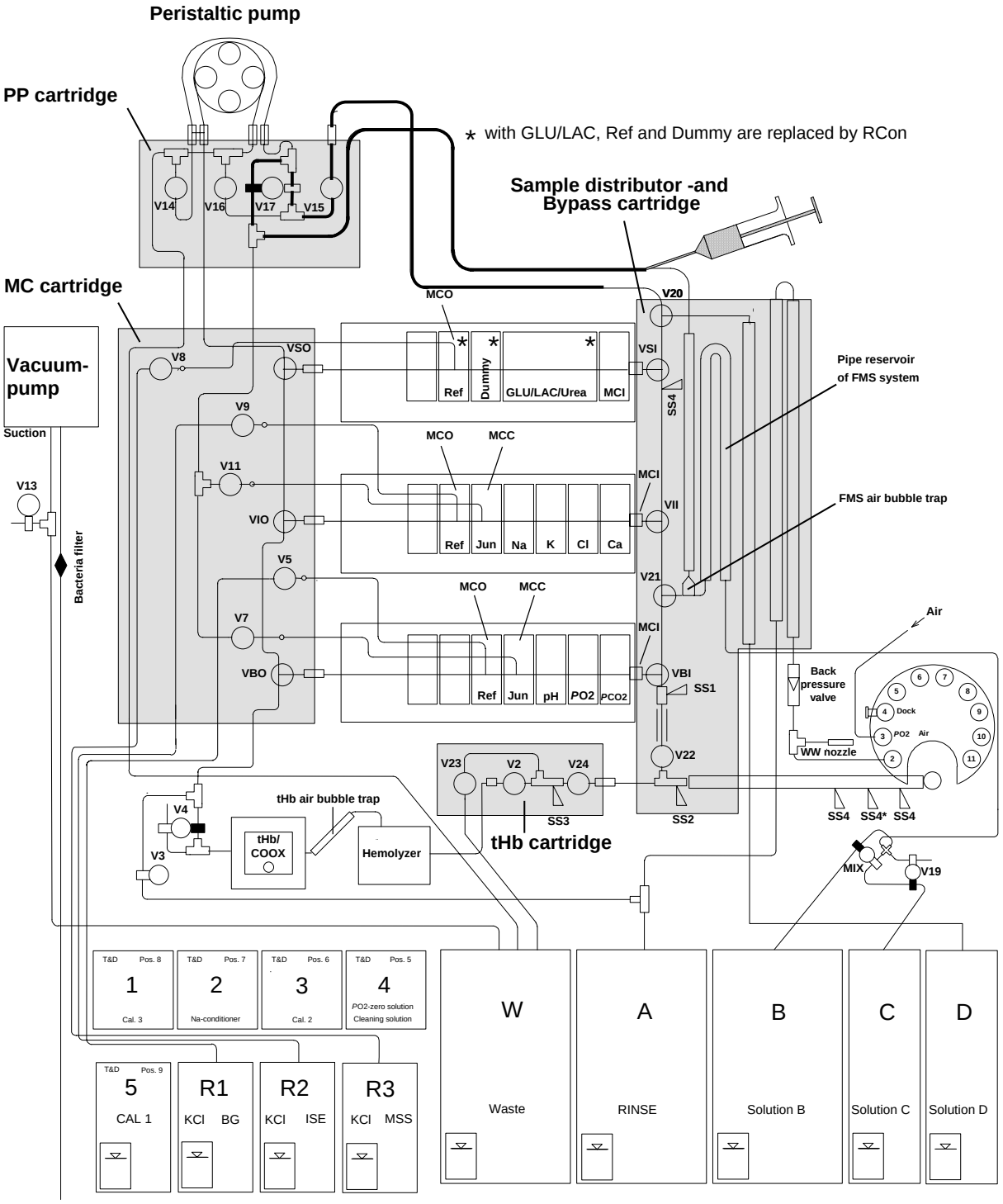


* SS6 at AVL OMNI 7, 8 and 9

Fig. 4: FMS volume error - errors of scenario 4

FMS volume error - errors of scenario 7 (test of V17)

path of test



* SS6 at AVL OMNI 7, 8 and 9

Fig. 5: FMS volume error - errors of scenario 6 (test of V17)

MC Cover error BG/
MC Cover error ISE/
MC Cover error MSS

Is the MC cover BG/ISE/MSS open?

no **yes**

Close MC cover.

Is the problem with the BG or ISE measuring chamber?

no **yes**

Hall sensor (BG/ISE) defective ⇒ change MC module (change see chapter 5).

MSS-measuring chamber.

- Cover switch (MSS) dirty ⇒ clean cover switch.
- Cover switch (MSS) defective ⇒ change MSS measuring chamber (change see chapter 5).

Rinse error general Simultaneously in bypass and sample distributor; also occurs in general as a consequence of a vacuum failure.

Press "**Continue**" and check the sample inlet path. Normally, a mixture of Solution A and air is aspirated in a ratio of about 1/3 during this washing.

Is Solution A aspirated?

yes

no

- Solution A not properly inserted ⇒ check bottle A for proper fitting.
- Tube connection between backpressure valve and SD blocked.
- Tubing connection(s) are disconnected ⇒ check all tubing connections (tubes disconnected because analyzer is open for example).
  Tubing between Solution A, V3 and back pressure valve defective.
- Back pressure valve does not function ⇒ check back pressure valve function (Solution A must be aspirated and should not flow back).
- Connection between bypass nipple and bottle compartment cartridge or tHb cartridge blocked.
- Check the thick silicon tube inside the analyzer on the SD block, in the Solution A aspiration path. This tubing connects the two metal heating tubes.
- No vacuum during the wash cycle. Check the position of the vacuum suction pipe on the black Waste cap T1.
- Bypass nipple is obstructed ⇒ check bypass nipple for free passage.

Only very little fluid is aspirated?

no

yes

- Solution A not properly inserted.⇒ check bottle A for proper fitting.
- Damaged or dirty fill port and/or T&D disk ⇒ clean or change fill port and/or T&D disk when damaged (cleaning see chapter 1, change see chapter 5).
- Leakage in the T&D area.
- Bypass nipple is obstructed ⇒ check bypass nipple for free passage.

Solution A flows as an almost complete fluid column?

no

yes

Wash water nozzle clogged.

Solution/air mixture (approx. 1/3) and washing function OK.

Sample sensor 2 defective.

Call up "**System - Test - Component Test - Valve Test**" and check V15, V16, V17, V22, V23 and V24 (if available).

Change valve if defective (change see chapter 5)

Bypass Rinse error

Press "**Continue**" and check the Bypass path.
Normally, a mixture of Solution A/air is aspirated during this wash cycle.

Is Solution A aspirated?

yes

no

Bypass is clogged or blocked.

Only very little fluid is aspirated.

no

yes

- Back pressure valve leaky (after longer pauses, Solution A flows back towards the bottle).
- Bypass partially blocked.

SS1 and SS2 are exchanged.

SD Rinse error

Press "**Continue**" and check the SD path.
Normally, a mixture of Solution A/air is aspirated during this wash cycle.

Is Solution A aspirated?

yes

no

- Tubing set at SD cartridge output not connected.
- Pump tubing set not connected.
- V15, V16 or V22 does not open.

Only very little fluid is aspirated.

no

yes

- Tubing under PP cartridge kinked.
- PP tubing not properly seated.
- Fill port area leaky.
- Leakage to sample inlet path.
- Fill port dirty (Cleaning see chapter 1 under "Decontamination").

SS2 and SS3 are exchanged (in devices with tHb- or COOX module only)

SD Cover error

Sample distributor cover is missing?

no **yes**

Assemble sample distributor cover.

- Sensor defective.
- Connections interrupted or disconnected.

SD Temp. error The following scenarios are built up in a logical way and are to be performed successively until the error source has been identified.

Scenario 1:

Call up "**System - Test - Module Test - Voltages**".

Voltage test OK?

yes . **no**

Power supply, Mainboard, Motherboard, electrical connections interrupted ⇒ **Scenario 2**.

Call up "**System - Test - Component Test - Sensors - Temperatures**".

SD temperature too high, SD temperature LED remains dark?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

- Direct sunlight ⇒ shading.
- Room temperature > 31 °C ⇒ reduce room temperature
- Filter dirty ⇒ change filter (change see chapter 5).
- Fan defective ⇒ change fan (change see chapter 5).
- Check plug connections **J12** on Motherboard.
- Change Mainboard (change see chapter 5).
- Change sample distributor (change see chapter 5).
- Change Motherboard (change see chapter 5).

SD temperature too high/low, SD temperature LED lights up?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

- Start up AVL OMNI™ again.
- Check for proper fitting of sample distributor cover.

Temperature too high/low, SD LED pulses every second?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard")

no . **yes**

Change sample distributor (change see chapter 5).

Temperature too low, SD LED remains dark.
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard")

- Check plug connections **J12** on the Motherboard.
- Change Mainboard (change see chapter 5).
- Change sample distributor (change see chapter 5).
- Change Motherboard (change see chapter 5).

Scenario 2:

Check voltages on Motherboard with a DVM (Testpins, see chapter 5, "Checking the supply voltage and the reference voltage").

Reference voltage +/-2.5 V not OK, but supply voltages +5 V, +/-12 V, +24 V are OK?

no . **yes**

Change Mainboard (change see chapter 5).

Reference voltage +/-2.5 V OK, but supply voltages +5 V, +/-12 V, +24 V are not OK?

- Change Motherboard (change see chapter 5).
- DC cabletree (**J5**) defective (change see chapter 5).
- Power supply defective ⇒ **Scenario 3**.

Scenario 3:

Check power fuse.

Fuse OK?

yes . **no**

Change fuse (change see chapter 5).

Power supply unit defective.

Change power supply (change see chapter 5).

Setup error

This error occurs when vital setup parameters (which are present in the file “deedata.kx“) are set to default, or deleted. Re-programming these parameters (listed bellow) resolves the error.

Blood type, sample container, language, calibration intervals, units, Passport, QC settings, economy mode settings, Hct factor, alarm beep setting, module priority, date format, start time sys.cal and interface setup are set to default values.

It is not crucial to re-program these values if not needed.

O2-UPol, Barometric pressure, Baro slope, Fill levels, sample counter, number of measurement report and AQC back flush error counter, are set to zero or default.

It is absolutely important to re-program the O2-UPol, Baro pressure, and Baro slope settings.

- Call up "**System - Util - Service Area - Setup**".

⇒ Reset to default or re-program lost values (see chapter 8 under "Service area - Setup").

SS error + additional information

Each sample sensor (SS**1**, SS**2**, SS**3**, SS**4** or SS**6** at AVL OMNI™ 7 to 9) corresponds to a number (see Fig. 1), which when added by 10 or only the number of the sensor indicates the following:

- **SS error (sample sensor + 10):**
  This indicates that the "dark" value is higher than the illumination value for the sensor. The cause is usually a defective Mainboard. Check or change the Mainboard.
- **SS error (sample sensor):**
  The signal is lower than 2000 mV (500 mV at SS**6**) or the "dark" value is higher than 5000 mV (2500 mV at SS**6**):

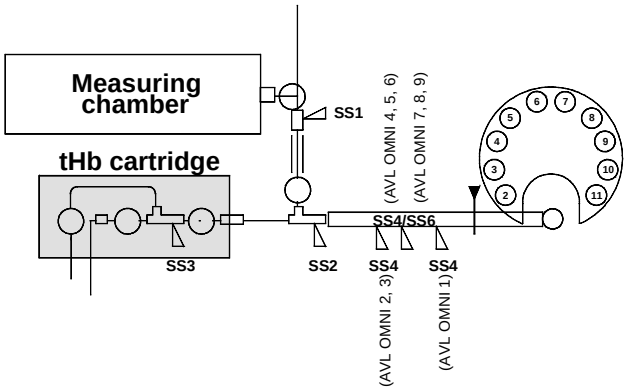


Fig. 6: Sample sensors

The additional information will be printed on the service report.

This error can also occur if fluid was present on the sensor during its calibration.

Press the "**Continue**" button, W/T process is called up. When the W/D cycle is performed properly, this error should be eliminated. If not, call up "**System - Test - Component Test - Sensors - Sample Sensors**" and check the "**cal mV**" value. Normally, when no fluid is present on the sensor this value should read about 4000 mV (2000 mV for SS**6**). Press the "**Cal.**" button to calibrate the sensors.

There is no fluid present on the sensor!

I_{Led} = 16 mA („light" value > 5000 mV?

no **yes**

- Electronic defective ⇒ change Mainboard (change see chapter 5).

Signal < 2000 mV?

no **yes**

- Check the sensor for contamination. Check if an external light source is interfering with the sensor.
- Check the optical light guide cable for kinks or sharp bends.
- Check the optical light guide connection to the Mainboard.
- Sensor damaged mechanically (change see chapter 5).

Is the respective cartridge assembled properly?

yes **no**

Assemble cartridge properly (assembly see chapter 5).

- Remove the cartridge and clean the sample sensor area with a cotton swab. Change the cartridge if cleaning does not help (change see chapter 5).
- Electronic defective ⇒ change Mainboard (change see chapter 5).

System error + additional information Error cause: undefined system malfunction
The error is corrected usually by switching the AVL OMNI™ off and on again.

Call up "**System - Util - Service Area - Special Tests - Optobus**" and check the Optobus errors. For detailed description of optobus errors see chapter 8.

T&D error A number always accompanies the T&D error. The interpretation of this number is listed below.

Number	Description	Possible cause
0	T&D OK	
11	Docking error	Mechanical error
12	No narrow slot found within 400 steps	Mechanical error
13	Narrow slot found, but no edge detected within 20 steps when turning back	Mechanical error
14	Narrow slot found, but subsequent docking error	Mechanical error
15	Light gate interrupted after approaching home position	light gate problems ⇒ re-initialize
16	Time-out 1	T&D SW error
17	Time-out 2	T&D SW error
41	Sample container shortly removed/reattached during measurement	Loose contact during removal of sample container
42	Time-out 3	T&D SW error
45	Undocking error. Level for successful undocking could not be detected within 400 steps.	Mechanical error
46	Undocking error, if T&D is already in the desired position and has to be undocked only	Mechanical error
47	Undocking error immediately before horizontal turn (origin not 0 or 1, target is position other than current one, but not 0 or 1)	Mechanical error
48 and 49	After undocking, the disk blocks the sample container detection (in devices with serial number < 7.016 only)	light gate problems ⇒ re-initialize
50	A position < > 0 was successfully approached. The sample container detection is however not interrupted after docking	disk not installed, sample container detection defective, stuck between 0/1
52	General docking error	Mechanical and/or electronic error
53	Docking error (if it stops in same position)	Mechanical and/or electronic error
54	Docking error at desired position during horizontal turn	Mechanical and/or electronic error
56	During turn, the disk moved the maximum number of steps, but the desired number of slots was not found	Mechanical error
57	Slot width not OK	Mechanical error
58	Time-out 4	T&D SW error
59	No slot was found within 75 steps from the narrow slot	Mechanical error
60	First slot was not found within 36 steps after movement start	Mechanical error
61	No further slot was found within 30 steps during turn	Mechanical error
62	The next slot was found within less than 55 steps from the narrow slot	Mechanical error
63	From position x, another position was found after only 18 steps	Mechanical error

Call up "**System - Test - Module Test - T&D System**" (all functions including the sample container detection are checked).

Does the disk dock concentrically on the fill port?

yes

no

- Depending upon the displayed error, change T&D control or T&D mechanics (change see chapter 5).
- Adjust T&D disk (adjustment see chapter 5)

Call up "**System - Test - Component Test - Sensors - Sample Container Detection**".
Display should read "**not detected**".
Insert capillary in the fill port and check if "**Sample Container Detected**" is shown.
Check up to which angle the capillary can be held and still be identified (min. ± 15°).

In case of error, check the connection of the photoconductor (D28). Check if the photoconductor is strongly bent, or miss-aligned, change sample container detection, change T&D control, change complete mechanics (change see chapter 5).

Temperature Errors

Scenario 1:

AVL OMNI™ modules are outside the permissible temperature range. Call up "**System - Test - Component Test - Sensors - Temperature**".

Room temperature > 31 °C?

no . **yes**

Room temperature must be lower than 31 °C.

↓

Temperature errors are intermittent?

no . **yes**

⇒ **Scenario 2**.

↓

Temperature deviation small (36 – 38 °C)?

no . **yes**

⇒ **Scenario 3.**

↓

Check actual temperature of failing module with thermometer inside the module.

Temperature indicated is same as measured?

no . **yes**

⇒ **Scenario 4**.

↓

All temperatures measured are not OK? (see Table 1, page 9-27)

no . **yes**

Check / change Mainboard and check temperature again.

↓

Check / change individual µC-module and check temperatures again.

Scenario 2:

Intermittent temperature errors occur suddenly during sample measurements?

no . **yes**

Check revision of Connector board ⇒ must be Rev. 9C or higher.

↓

⇒ **Scenario 3.**

Scenario 3:

Filter dirty?

no . **yes**

Clean / change filter (change see chapter 5).

↓

Check fan[1], power supply and connector.

Scenario 4:

Temperature is about 47 °C?

no . **yes**

Switch unit off and on and check module temperatures again.
If not OK again, check Mainboard, failing module, interconnections.

↓

Temperature is about 35 °C: Temp. LED on Mainboard dark?
(see chapter 5 description of LED's on Mainboard)

no . **yes**

No heating current⇒ Possible failure causes:

- Thermal fuse
- 24 V DC not OK
- Module failure
- Mainboard
- Interconnections

↓

Check Mainboard.

Function description and comparisons of the used temperature controllers:
For further information see also chapter 5.

All controllers are closed loop controllers; additional features see Note 1 and Note 2.

[1] The fan at the rear panel strongly influences the efficacy of the thermal controllers. The airflow will increase continuously with the ambient temperature between 22 °C (minimum flow) and 28 °C (maximum flow).

	Heating element	Sensor[2]	Thermal fuse	Controller on	Fixed temp.	Remarks
BG/ISE measuring chamber (see also Note 1)	Heating foil	PTC	EV0148 65 °C +/2%	BB0520 MC heat control	37.0 +/-0.2 °C (42 °C by Software)	Supply 24 DC, connections via Connector board to Motherboard and Mainboard Temp. amplifier on BB0520, ADC on BA0866
BG/ISE measuring chamber cover	Ceramic heater and 5 power transistors	NTC[3]	no	BB0534 Cover heat control	37.0 +/-0.5 °C	Supply 24 V DC, Connection to BB0520 (MC heat control)
SD	5+2 power transistors	PTC[4]	EV0071 72 °C +/-10%	BB0582 Distributor heat control	37.5 +/-0.6 °C	Supply 24 V DC, Connection to Motherboard Temp. amplifier on BB0582, ADC on BA0866
tHb-measuring chamber	2 power transistors	NTC	EV0141 71 °C +/-10%	BB0551 tHb-Board	37.0 +/-0.5 °C	Supply 24 V DC, connection to Motherboard Temp. amplifier on BB0551, ADC on BA0866
COOX-measuring chamber (see also Note 2)	2 power transistors	NTC	no	BB0725 PolyOx-Heat, PolyOx-KX-Control	37.0 +/-0.2 °C	Supply 24 V DC, connection to PolyOx-KX-Control Temp. amplifier & ADC on PolyOx-KX-Control

Table 1

Note 1: Function of heating control for BG/ISE measuring chamber:
In general, the temperature is measured and checked continuously.

Coldstart:
10 min heating up time is needed in any case.
If module temperature is lower than 32 °C, during heating up process temperature is set from software by the µC and one DAC (on Mainboard) to 42 °C for faster heating and is then reduced to the fixed temperature.
If module temperature is > 32 °C, temperature controlling without this overshooting to 42 °C is done.

Normal operation:
If temperature is within the allowed +/- 0.2 °C (+/- 0.6 °C) temperature limit, the mean value of the temperature measurements over a long time period (once per day at the system calibration) is calculated and adjusted automatically by the software to the ideal value in order to minimize drift effects.

[2] Sensor and thermal fuse are always built into that module to be thermostated.
[3] NTC = Negative temperature coefficient resistors, precision type.
[4] PTC = Positive temperature coefficient resistors, precision type.

However, it is not possible to call up this adjustment procedure by an additional system calibration.

Note 2: Temperature controller for COOX module:
The controller- and temp. measuring circuitry is located on the PolyOx-KX-Control, only the heating transistors and the sensor are located on the PolyOx-Heat, directly in the measuring block.

UC Memory Overflow

Optobus connection between PC and microcontroller (Mainboard) has been interrupted too long:

Bad or missing Optobus connection between PC and MC?

no **yes**

Reestablish Optobus connection.

↓

Possible software crash ⇒ switch AVL OMNI™ off and on again.

Vacuum error

If a vacuum error is displayed, the cause of the error can be detected with the aid of the automatic test procedure.

Scenario 1:

Troubleshooting comprises individual diagnostic cycles, which can be enabled by activating "**System - Util - Troubleshooting - Vacuum Error**".
Detailed information on error causes and remedies will be displayed after completion of the test procedure upon pressing "**More Details**".
Follow the instructions on the screen!

The key "**Testrun 2**" will only be displayed, if at least one of the criteria 3-5 below shows a "**Not OK**" as a result.

The five evaluation criteria are:

KI Vacuum sensor offset
K2 Vacuum generated after 2 seconds
K3 Vacuum generated after 10 seconds
K4 Maximum value
K5 System tightness after vacuum pump off
K6 Drop in pressure after valves opened

If a vacuum error is displayed, the error source can also be localized with the help of the "Vacuum sensor test". Call up "**System - Test - Component Test - Sensors - Vacuum Sensor**".

If the error cannot be detected using the automatic test procedure, please continue with the procedures described in the following.
The following scenarios are built up in a logical way and are to be performed successively until the error source has been identified.

Scenario 2:

Is the Waste container inserted correctly?

yes . **no**

Insert Waste container correctly.

↓

Tubes to and from Waste container loose?

no . **yes**

Connect supply tubes properly.

↓

Container pipe has been damaged?

no . **yes**

Change Waste cap T1 (change see chapter 5).

↓

Is the vacuum pump running?

yes . **no**

Vacuum pump or control defective (change see chapter 5).

↓

Whistling noise in the waste area?

no . **yes**

Leaky Waste connections.

↓

Check tubings and connections to the pump and Waste container or the vacuum sensor.

Scenario 3:

Call up "**System - Test - Component Test - Sensors - Vacuum Sensor**" and read the mV values after 2, 10 and 60 seconds of switching the pump On.

Is the mV value after 2 seconds > 1500 mV?

no . **yes**

- The vacuum build up is too fast.
- Tubing line between vacuum sensor and Waste container is blocked.
- The container pipes has not completely penetrated the bottle plug:

↓

Is the mV value after 10 seconds < 620 mV or after 60 seconds < 1300 mV?

no . **yes**

- Vacuum pump not functioning optimally ⇒ aspirate a couple of water drops into the vacuum pump via the container pipe in Waste cap T1. This usually revives the pump functioning.
- Improper sealing or leakage⇒ **Scenario 4**.
- Vacuum sensor defective (change see chapter 5).

↓

Repeat test (system is operating on its limit or time not measured properly).

Scenario 4:

Remove rear panel (see chapter 5),
call up "**System - Test - Component Test - Sensors - Vacuum Sensor**". After 60 seconds of switching the pump on, pinch the tube between vacuum pump and vacuum sensor connection.
There should be a minimal drop in pressure and the mV value.

Drop in pressure > 20 mV/sec.

no **yes**

System is leaking ⇒ **Scenario 5**.

Repeat test (system is operating on its limit or time not measured properly).

Scenario 5:

Remove Waste container.
Block the rear Waste connection (container pipe) with tissue (risk of infection!), and remove rear panel (see chapter 5). Call up "**System - Test - Component Test - Sensors - Vacuum Sensor**". After 5 seconds of switching the pump on, pinch the tube between vacuum pump and vacuum sensor.

Drop in pressure > 20mV/sec?

no **yes**

System is leaking between vacuum pump and Waste container:
Tubing or V13 leaking.

Pre-requisite: Leakage was found in Scenario 3.

- Waste-coupling parts are leaky.
- System is leaky between Waste container and V23 or V23 does not seal properly.
- System is leaky between the Waste container and the peristaltic pump (cartridge plug or connection of the peristaltic pump tubes).

Version error + additional information The additional information given in case of a version error provides more detailed information on why the microprocessor software and the PC software do not match.

The cause of the error may be that the AVL OMNI™ software version does not match the existing hardware configuration.
The displayed message for example is "**Version error UC: OMNI 4** and **PC: OMNI 6**" but your device is an AVL OMNI™ **4**. The message means that the microprocessor software recognizes an OMNI 4 and the PC software an OMNI 6.
In this case call up "**System - Util - Service Area - Switches 1**" and turn "**Service Keyboard**" - "**On**".
Change to the DOS-level by pressing "**F10**" and enter (e.g. for AVL OMNI™ 4) "**setvers 4**".
Switch off the AVL OMNI™ and on again.

Software version OK?

yes ↓

no

Perform "**setvers x**" or install software with correct AVL OMNI™ version (see also chapter 8 under “Software update”).

- Module improperly connected ⇒ check connection of the BG/ISE/MSS module to the Motherboard.
- Optobus connection to COOX module not established, or interrupted ⇒ check connections.

System warnings

Displayed in message window and service report.

AutoQC: Check Materials ! (only if an AutoQC module is installed)

This warning shows up because only 2 ampoules of a certain level are remaining on the mat ⇒ install new ampoule mat.

AQC Cover open (only if an AutoQC module is installed)

AutoQC cover open?

no ↓

yes

Close AutoQC cover.

Switch of AutoQC cover defective.

AQC pos. error (only if an AutoQC module is installed)

If an AQC pos. error occurs, a number is printed on the service report. The interpretation of these numbers is listed below.

Number	Description	Possible cause
1	X-home position reached too soon	Horizontal slide adjusted manually, Motor (incremental encoder) defective
2	X-home position reached too late	Horizontal slide adjusted manually, Motor (incremental encoder) defective
3	X-motor blocked for more than 50ms	Motor (incremental encoder) defective, mechanical blockage of slide
4	X-light barrier responds unexpectedly	Light barrier at AQC control board defective
5	Cover was opened during X-positioning	
6	X-timeout; action could not be terminated within 6 seconds	Too much friction
7	Y-home position reached too soon	Horizontal slide adjusted manually, Motor (incremental encoder) defective
8	Y-home position reached too late	Horizontal slide adjusted manually, Motor (incremental encoder) defective
9	Y-motor blocked for more than 50ms.	Motor (incremental encoder) defective, mechanical blockage of slide
10	Y-light barrier responds unexpectedly.	YZ-Distributor Board defective
11	Cover was opened during Y-positioning	
12	Y-timeout; action could not be terminated within 6 seconds	Too much friction
13	Z-home position reached too soon	Horizontal slide adjusted manually, Motor (incremental encoder) defective
14	Z-home position reached too late	Horizontal slide adjusted manually, Motor (incremental encoder) defective
15	Z-motor blocked for more than 50ms.	Motor (incremental encoder) defective, mechanical blockage of slide
16	Z-light barrier responds unexpectedly.	Z-distributor board defective
17	Cover was opened during Z-positioning	
18	Z-timeout; action could not be terminated within 6 seconds	Too much friction
19	illegal XY-position	⇒ Z-movement is not performed
20	Home position could not be reached, process terminated	Mechanical blockage
21		Attempt to approach illegal position.
22	During component test only	
23	X adjustment error, ampoule block not found	Ampoule block not installed or tolerances to high
24	Y adjustment error, ampoule block not found	Ampoule block not installed or tolerances to high
25	User termination	
26	Value detected during adjustment was outside permissible range	Tolerances too high
27	X-direction: ampoule block already detected during first attempt	Ampoule block incorrectly installed
28	Y-direction: ampoule block already detected during first attempt	Ampoule block incorrectly installed

Call up "**System - Test - Component Test - Aggregates AutoQC - Motors**" and perform a test of the X/Y/Z-axes. The range of expected values is mentioned on the display.

Measured value current ≈ 0 mA?

no . **yes**

- Cables to motors defective.
- change YZ-distributor board, Z-distributor board or AQC control board (change see chapter 5).

Measured value current > 250 mA?

no . **yes**

Mechanical motor blockage (defective gearbox) ⇒ change motor (change see chapter 5).

Speed and acceleration value too low?

no . **yes**

Mechanical blockage

Speed and acceleration value too high.

- Toothed belt is slipping.
- Defective gearbox ⇒ change motor (change see chapter 5).

Call up "**System - Test - Component Test - Aggregates - AutoQC - Positions - Go to Position**" and set 120.
(The Z-slide has to be in upward position).

Motor moves into position 120?

no . **yes**

X and Y axis function is OK.

Mechanical blockage

Select button "∇ (needle to aspiration position)". Does the steel tube go down as required?

no

Steel tube is blocked ⇒ Toothed gear unit defective ⇒ Change the horizontal slide unit.

AQC SS error
(only if an AutoQC
module is installed)

Call up "**System - Test - Component Test - Aggregates - AutoQC - Sample Sensor**".

Sample sensor is OK and the LED current is between 1 to 20 mA?

no . **yes**

Select "**Start Test**".

Sample sensor is OK but the LED current is between 20 to 60 mA? (typical current is about 5 mA)

no . **yes**

Residual fluid in the area of the sample sensor ⇒ remove residual fluid.
After removing the residual fluid call up "**Sample Sensor**" as above again, as the sensor re-calibrates when this program is accessed.

Select "Start Test" again. Sample sensor is not OK, the LED current is > 60 mA and the dark current value is < 20 mV?

no . **yes**

- Residual fluid in the area of the sample sensor ⇒ remove residual fluid.
  After removing the residual fluid call up "**Sample Sensor**" as above again, as the sensor re-calibrates when this program is accessed.
- Barex tube defective ⇒
  Remove Phillips screw from the horizontal slide and disconnect barex tube from the tubing at the steel tube. Move barex tube approx. 1 cm and call up test again.

Sample sensor not OK, LED current > 60 mA and dark current value < 20 mV?
Sample sensor not OK, LED current < 1.mA?

no . **yes**

- LED of light guide is not working, sensor connection interrupted ⇒ change flex cable (long), flex cable (short), YZ-distributor board, Z-distributor board or AQC control board (change see chapter 5).
- Sample sensor defective ⇒ change Z distributor board (change see chapter 5).
- Amplifier defective ⇒ change AQC control board (change see chapter 5).

Sample sensor is not OK and the dark current value > 200 mV?

Sample sensor defective ⇒ change Z distributor board (change see chapter 5).

Remove Phillips screw from the horizontal slide and disconnect barex tube from the tubing at the steel tube. With a syringe, inject water into the barex tube and activate "**Start Test**".

Status = sample?

no **yes**

↓ OK.

Status = no sample.

Sensor provides same signal with and without water This implies that the barex tube is defective ⇒

- Move barex tube approx. 1 cm and call up test again.
- Sample sensor defective ⇒ change Z-distributor board (change see chapter 5).
- AQC control board defective (change see chapter 5).

AQC Temp. Error

After instrument power-up, the current temperature is taken by the software, as the mean temperature of the past hours. This may cause a prolonged temperature error (up to a few hours), if the instrument was stored at temperatures < 10 °C or > 40 °C, just prior to switching on.

Call up "**System - Test – Component Test - Aggregates - AutoQC - Temp. Sensor**".
Typical values: between 23 to 28 °C.

Temperature < 10 °C?

no · **yes**

Temperature is ***below*** the permissible range.
(Caution: the evaluation is based on a weighted value of the last few hours; the display shows the current temperature).

Ensure that the ambient temperature lies within instrument specifications. Check if AQC cover is closed.

Temperature > 40 °C and < 200 °C?

no · **yes**

Temperature ***exceeds*** the permissible range.
(Caution: the evaluation is based on a weighted value of the last few hours; the display shows the current temperature).

Ensure that the ambient temperature lies within instrument specifications. Check if AQC cover is closed.

Temperature ≥ 200 °C.

Temperature sensor is not installed or does not emit data.

- Check cable, sensor connected?
- Replace sensor.
- Replace AQC Control Board.
- SN < 500: Upgrade of AQC temperature sensor was not made or was not retrofitted properly.
- AQC temperature sensor is not installed, but mistakenly switched on in the software under "**System -Util – Service Area - Switches - AQC Temp. Correlation**" is "**On**".

NOTE: *Do not install or remove the AQC temperature sensor when the system is connected to power.*

AQC Wash error (only if an AutoQC module is installed)

Check the wash port of the AutoQC module for glass splinters.

1. If an AQC wash error is displayed, the error can be eliminated by manually calling up an AQC wash routine. To do this, call up "**Options - AutoQC - Wash**".

2. The error can also be detected with the aid of the automatic test procedure. This troubleshooting comprises of several individual diagnostic cycles, which are enabled automatically.
   During the diagnostics of the AQC Wash error, the following components are tested by the main control:
   - Vacuum
   - AutoQC module
   - Bypass
   - Sample distributor

   Activate "**System - Util - Troubleshooting - AutoQC Wash error**". More detailed information on possible causes and remedies can be displayed upon completion of the test procedure by pressing the "**More Details**" key.

   Follow the instructions on the screen!

BG/ISE Temp Error

General:

The temperature sensors for the closed loop temperature sensors are NTCs (neg. temp. coeff.) or PTCs (pos. temp. coeff.).
Refer to the corresponding block diagram (chapter 5) to find out whether a NTC or PTC is used.
Possible error causes according to the characteristic of a NTC/PTC:

NTC:

- High temperature indicated, but module is cold:
  NTC is short-circuited or short-circuit in the signal path.
- Low temperature indicated, but module is hot
  (thermal energy is limited by a thermal fuse or the available power):
  open NTC circuit or interruption in the signal path.

PTC:

- High temperature indicated, module is hot
  (thermal energy is limited by a thermal fuse or the available power):
  open PTC circuit or interruption in the signal path.
- Low temperature indicated, module is cold:
  PTC is short-circuited or short-circuit in the signal path.

The following scenarios are built up logically and are to be performed successively until the error source has been identified.

Scenario 1:

Call up "**System - Test - Module Test - Voltages**".

Is the voltage test OK?

yes . **no**

Power supply, Mainboard, Motherboard, electrical connections interrupted ⇒ **Scenario 2**.

Call up "**System - Test - Component Test - Sensors - Temperatures**"
Temperature too high, BG/ISE LED remains dark?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

- Direct sunlight ⇒ shading.
- Room temperature > 31 °C ⇒ reduce room temperature
- Filter dirty ⇒ change filter (change see chapter 5).
- Fan defective ⇒ change fan (change see chapter 5).
- Check connection (**J18** [BG] / **J19** [ISE] on Motherboard or **J7** on Connector board).
- MC cover overheated ⇒ **Scenario 3**.
- Change Mainboard (change see chapter 5).
- Change BG/ISE module (change see chapter 5).
- Change Motherboard (change see chapter 5).

Temperature too high/low, LED lights up?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

Start up AVL OMNI™ again.

Temperature too high/low, LED pulses every second?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

Change BG module (change see chapter 5).

Temperature too low, LED remains dark?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

- Check connections (**J18/J19** on Motherboard or **J7** on Connector board).
- Change Mainboard (change see chapter 5).
- Change BG module (change see chapter 5).
- Change Motherboard (change see chapter 5).

Check MC cover temperature.

MC cold (room temperature)?

no . **yes**

- Supply interrupted ⇒ check connection (6-pol. flat cable inside measuring module).
- Change MC cover (change see chapter 5).

MC luke warm (37 °C)?

no . **yes**

MC cover OK.

MC hot.

NTC interrupted ⇒ change the BG/ISE module (change see chapter 5).

Scenario 2:

Check voltages on Motherboard with DVM (Testpins, see chapter 5, "Checking the supply voltage and the reference voltage").

Reference voltage +/-2.5 V not OK, but supply voltages +5 V, +/-12 V, +24 V are OK?

no . **yes**

Change Mainboard (change see chapter 5).

Reference voltage +/-2.5 V OK, but supply voltages +5 V, +/-12 V, +24 V are not OK?

- Change Motherboard (change see chapter 5).
- DC cabletree (**J5**) defective (change see chapter 5).
- Power supply defective ⇒ **Scenario 4**.

Scenario 3:

Check power fuse.

Fuse OK?

yes ·

↓

no

Change fuse (change see chapter 5).

Power supply unit defective.

Change power supply (change see chapter 5).

Change PP Tubes !

(AVL OMNI™ 2, 3, 5, 6, 8 and 9 only)

The positioning time during a Hb-measurement is used to derive the load limit for the aspiration speed. If this time is below 50 (0.5 seconds) or above 370 (3.7s), the system prompts the user to replace the tubing. The tubing replacement including time of replacement is then entered in the maintenance database and the warning disappears.

Message reappears despite tubing replacement after 4 Hb-measurements?

no ·

↓

yes

- New tube is also defective ⇒ Replace again (change see chapter 5).
- Pump head defective ⇒ change pump head (change see chapter 5).

PP-tubing was defective.

The time established is below 50?

no ·

↓

Yes

- Leak or blockage in aspiration path.
- The system is too slow ⇒ check tubing to tHb/COOX-module (too long?).

- Sedimentation in cuvette (perform cleaning or replace cuvette) or light level too low.
- The system is too fast ⇒ check tubing to tHb/COOX-module (too short?).

Check Cleaning Solution !
(Solution 6)

This warning is flashed when automatic cleaning with Solution 6 is activated (service area) and no sample is detected at SS2.

Solution 6 empty?

no **yes**

- Insert new bottle.
- Activate cleaning routine.
  Warning disappears as soon as solution is aspirated.

- Check aspiration paths via T&D – position 11.
- Activate cleaning routine.
  Warning disappears as soon as solution is aspirated.

Check Solution 2 ! / Check Solution 4 !

This error is flashed because the level counter for the bottle has reached the alarm level, and two subsequent aspirations show a “no sample”.

Bottle empty?

no **yes**

Insert new bottle.

Aspiration problem.

T&D module (pos. 5 or pos. 7) or fill port dirty ⇒ cleaning see chapter 1.

Check Date/Time !

This message is a warning that the date/time on the AVL OMNI™ should be checked. The alarm flashes because the date/time is too out of synchronization with the next scheduled calibration time.

- The usual cause is that the AVL OMNI™ was kept switched off for more than 96 hours.
- The date/time setting in the Bios (on the PC) has jumped forwards or backwards.
- Battery defective.
  AT96 (SN >2300; older revision levels see chapter 10): Battery is located on the Interface board.
  PC104 (SN 1500 - 2565): Battery is located on the PC board MSM486V ⇒ change entire board.

The message stops flashing when the date/time is set on the AVL OMNI™.
Activate: "**System - Setup - Time & Intervals - Date/Time**".

Check Fill Levels !

One of the reagent bottles is nearly empty ⇒ a bottle change must be made soon.

Check MSS Solutions !

One of the MSS reagent bottles is nearly empty ⇒ replace bottle soon.

Cl Electrode Dirty (Defect)

This alarm is flashed when the slope of the Cl electrode falls below 100 mV. This is usually resolved by cleaning the electrode.

- Activate "**System - Util - Analyzer Actions - Fluid Actions - Cleaning Routines**".
- Activate the ISE module and press "**Start External Cleaning**".
- Introduce the external cleaning agent in the fill port.
- After the cleaning routine is done, stay in "**Fluid Actions**". Call up "**Wetting Electrodes – ISE Electrodes**". Perform a wetting with a wetting agent (e.g. whole blood).

The system automatically starts a calibration after exiting the program.

Another manner to resolve this error is to clean the Cl electrode with the dental floss provided in the cleaning kit.

- In the "**Ready**" mode, open the ISE MC cover, and remove the Cl electrode.
- Gently pull the dental floss as described in AT0427 through the electrode, once.
- Re-insert the electrode, close the measuring chamber, and wait for the warm-up to complete.
- When the AVL OMNI™ returns to "**Ready**", activate "**System - Cal - System Cal.**".

COOX Lamp error
(AVL OMNI™ 3, 6 and 9 only)

Call up "**System - Util - Service Area - Switches 1 - Avopto Report On**".

Alarm on Avopto report: 00000000 00000400
COOX lamp error: 1?

no **yes**

- Control problems with halogen lamp - Control diode not connected ⇒ connect control diode.
- Control problems with halogen lamp - control diode defective ⇒ change lamp holder (change see chapter 5).

Call up "**System - Util - Service Area - COOX-Module - Optics Test - Neon Lamp On**".

Alarm on Avopto report: 00000000 00000400
COOX lamp error: 2?
The voltage measured at the neon lamp connector is >90V or <60V.

no **yes**

- Neon lamp supply voltage not OK ⇒ change lamp unit (change see chapter 5).
  NOTE:
  Impedance of the neon lamp cannot be measured with DVM (gas discharge lamp)!
- PolyOx-KX-control 9700 LY3 defective (change see chapter 5).

Call up "**System - Util - Service Area - COOX Module - Optics Test**".
Open cover of cuvette holder and activate "**Neon Lamp On**".

Alarm on Avopto report: 00000000 00000400
COOX lamp error: 64?
The light of the halogen lamp is clearly visible through the borehole above the cuvette.
The voltage measured at the connector pins of the halogen lamp should be 11.5 V +/- 0.4 V.

no **yes**

Supply voltage of halogen lamp not OK ⇒ change PolyOx-KX-control 9700 LY3 (change see chapter 5).

Halogen lamp is not illuminated and voltage is too great.

Halogen lamp defective ⇒ change lamp holder (change see chapter 5)

***NOTE*:** *If for example, COOX lamp error: 1 and a COOX lamp error: 64 occur simultaneously, the error codes are added and the code 65 is issued on the Avopto report.*

Lamp error 2
(AVL OMNI™3, 6 and 9 only) Display in calibration or electrode status report.

Printout a calibration or electrode status report under: "**Options - Reports**".

Lamp error or calibration flag 53 is printed:

Check entire light path (light guides, prism, cuvette scratched or very dirty). Change see chapter 5.

COOX HW error
(AVL OMNI™ 3, 6 and 9 only)

Perform PolyOx-KX-control 9700 LY3 hardware test: Check whether +24 V are applied, press reset key: LED 2 lights up when reset key is pressed. After releasing the key, an acoustic signal sounds twice and 4 seconds later, once.

No acoustic signal or continuous tone?

no . **yes**

- EPROM on PolyOx-KX-control 9700 LY3 is defective ⇒ change EPROM.
- Processor or components defective ⇒ change PolyOx-KX-control 9700 LY3 (change see chapter 5).

↓

- Check LED's. (Description see chapter 5).

Call up "**System - Util - Service Area - Switches 1 - Avopto Report On**".

Alarm on Avopto report: 00000000 00000800
COOX HW error: 4?

no . **yes**

ADC error ⇒ change PolyOx-KX-control 9700 LY3 (change see chapter 5)

↓

Alarm on Avopto report: 00000000 00000800
COOX HW error: 16?

no . **yes**

Supply voltage error ⇒ change PolyOx-KX-contro1 9700 LY3 (change see chapter 5)

↓

Alarm on Avopto report: 00000000 00000800
COOX HW error: 32.

Cuvette heater error ⇒ change Cuvette holder and/or PolyOx-KX-control 9700 LY3 (change see chapter 5).

COOX Slave error
(AVL OMNI™ 3, 6 and 9 only)

Call up "**System - Util - Service Area** - **Switches 1 - Avopto Report On**".

Alarm on Avopto report: 00000000 00001000
COOX slave error: 8

Communication error between PolyOx-KX-control 9700 LY3 and polychromator:

Flat cable of the polychromator not connected?

no **yes**

Connect flat cable.

↓

Replace polychromator (change see chapter 5).

COOX Temp error
(AVL OMNI™ 3, 6 and 9 only)

Cuvette heater connected? (flat cable from cuvette holder to PolyOx-KS-control-9700-LY3)

no **yes**

Measure voltage at NTC on PolyOx-KX-control 9700 LY3: **J8/4** - **J8/I1** -desired value: 300...215O mV.

Call up "**System - Util - Service Area** - **Switches 1 - Avopto Report On**".

Alarm on Avopto report: 00000000 00000800
COOX temp. error: 32

NTC shorted or interrupted ⇒ change cuvette holder (change see chapter 5)

↓

Connect cuvette heater and reset PolyOx-KX-control 9700 LY3.

Glu is defective/
Lac is defective/
Urea is defective
(AVL OMNI™ 7 to 9 only)

(See also “MSS status”, page 9-98).

This alarm is flashed on replacing the MSS sensor, just after the blood wetting, when the Glu, Lac or Urea sensor fails the first evaluations with Solution 3 and Solution D.

- Wait to see if two of the three parameters will be ready after the first calibration in 1-2 hours. If this is acceptable, the defective sensor can be deactivated and the other sensors are still usable.
- If it is necessary that the defective sensor also works, replace the MSS sensor and conduct polarization as described.

DB archiving !

Data archiving is beeing performed.

Hemolyzer error

(AVL OMNI™ 2, 3, 5, 6, 8 and 9 only)

The following scenarios are built up in a logical way and are to be performed successively until the error source has been identified.

Scenario 1:

Call up "**System - Test - Module Test - Voltages**".

Voltage test OK?

yes . **no**

Power supply, Mainboard, Motherboard, electrical supply interrupted ⇒ **Scenario 2**.

Call up "**System - Test - Component Test - Aggregates - COOX Module - Hemolyzer**".
Normally, the red LED on the Hemolyzer board (HS board) should glow brightly and stop with the hemolyzer test saying OK.

Does the LED just glimmer or blink twice, weakly?

no . **yes**

- Check hemolyzer connections (**J2** on HS board).
- Change hemolyzer (change see chapter 5).
- Change HS board (change see chapter 5).

Disconnect the connector J2 between the hemolyzer and the HS board, and activate above test again. Does the LED remain dark?

no . **yes**

- Check connection **J8** on Motherboard.
- Change HS board (change see chapter 5).
- Change Motherboard (change see chapter 5).

Reconnect the connector J2 between hemolyzer and HS board, and activate the test again. Does the LED still remain dark?

Change hemolyzer (change see chapter 5).

Scenario 2:

Check voltages on Motherboard with DVM (Testpins, see chapter 5, "Checking the supply voltage and the reference voltage").

Reference voltage +/-2.5 V not OK, but supply voltages +5 V, +/-12 V, +24 V are OK?

no **yes**

Change Mainboard (change see chapter 5).

Reference voltage +/-2.5V OK, but supply voltages +5 V, +/-12 V, +24 V are not OK?

- Change Motherboard (change see chapter 5).
- DC cabletree (**J5**) defective (change see chapter 5).
- Power supply defective ⇒ **Scenario 3**.

Scenario 3:

Check power fuse.

Fuse OK?

yes **no**

Change fuse (change see chapter 5).

Power supply unit defective.

Change power supply (change see chapter 5).

ISE Temp error

(AVL OMNI™ 4 to 9 only) Troubleshooting like "BG Temp error", page 9-38.

Lac is defective

(AVL OMNI™ 7 to 9 only) See page 9-45.

Maintenance pending

A maintenance procedure has to be performed. ⇒ Perform maintenance, corresponding AVL OMNI™ Operator's Manual, chapter 9, "Maintenance".

MSS Temp Error
(AVL OMNI™7 to 9 only)

The following scenarios are built up logically and are to be performed successively until the error source has been identified.

Scenario 1:

Call up "**System - Test - Module Test - Voltages**".

Is the voltage test ok?

yes . **no**

Power supply , Mainboard, Motherboard, electrical. connections interrupted ⇒ **Scenario 2**.

Call up "**System - Test - Component Test - Sensors - Temperatures**".

Temperature too high, MSS LED lights?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

- Direct sunlight ⇒ shading.
- Room temperature > 31 °C ⇒ reduce room temperature
- Filter dirty ⇒ change filter (change see chapter 5).
- Fan defective ⇒ change fan (change see chapter 5).
- Check connection (**J20** on Motherboard or **J7** on Connector board).
- MC cover does not close properly ⇒ check insulation and metal bracket inside the cover.
- Change Mainboard (change see chapter 5).
- Change MSS module (change see chapter 5).
- Change Motherboard (change see chapter 5).

Temperature too high/low, MSS LED lights up?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

no . **yes**

Start up AVL OMNI™ again.

Temperature too low, MSS remains dark?
(see chapter 5, "Mainboard - Description of the DIL switch and LED's on the Mainboard").

- Room temperature < 15 °C.
- Check connections (**J20** on Motherboard or **J7** on Connector board).
- Change Mainboard (change see chapter 5).
- Change MSS module (change see chapter 5).
- Change Motherboard (change see chapter 5).

Scenario 2:

Check voltages on Motherboard with a DVM (Testpins, see chapter 5, "Checking the supply voltage and the reference voltage").

Reference voltage +/-2.5V not OK, but supply voltages +5V, +/-12V, +24V are OK?

no . **yes**

Change Mainboard (change see chapter 5).

↓

Reference voltage +/-2.5V OK, but supply voltages +5V, +/-12V, +24V are not OK?

- Change Motherboard (change see chapter 5).
- DC cabletree (**J5**) defective (change see chapter 5).
- Power supply defective ⇒ **Scenario 3**.

Scenario 3:

Check power fuse.

Fuse OK?

yes . **no**

Change fuse (change see chapter 5).

↓

Power supply unit defective.

Change power supply (change see chapter 5).

MSS polarization not ok
(AVL OMNI™7 to 9 only)

Possible error causes:

- The volume of the blood sample used for polarization was either not enough, or had air bubbles included.
- Immediately after the blood polarization, the initial Sol. 3, Sol. D or Ref. Sol. 3 (for urea) aspirations show „**no sample**“.
- Alarm is also caused due to an automatic or manual termination of the polarization process due to for instance; opening the bottle compartment cover, or measuring chamber cover, etc.
- Check levels of Sol. 3, Sol. D & Ref. Sol. 3 (for urea); and check if the aspirations are OK.
- Check that the Waste container is not nearly full. If nearly full, replace.
- Arrange for adequate volume of fresh whole blood, and repeat the polarization.
- Activate "**Options - MSS Pol.**"

Perform Cleaning !

This warning flashes when automatic cleaning is ***not*** activated and the number of measurements exceeds the preset limit for cleaning.

Solution 6 installed?

no **yes**

- Activate automatic cleaning under "**System - Util - Service Area - Switches 2 - New Cleaning Sol. - On**".
- Manually activate internal or external cleaning.
- Manually activate system calibration.
- Wait for next system calibration which will perform a cleaning of the respective module.

Manually activate external cleaning.

Poly. Cal not OK

This warning flashes when the COOX calibration has failed.

- A usual cause is a dirty tHb cuvette. Clean the cuvette with deproteinizer (see Operator's Manual, chapter 9, "Maintenance", section "Cleaning the COOX module").
- If the contamination is persistent ⇒ change cuvette (change see chapter 5).

Perform Polychr. cal. and COOX cal again.
Call up "**System - Cal - Polychr. Cal.**"

And "**System - Cal - COOX Cal.**"

If the calibration still does not pass, call up "**System - Util - Service Area - COOX Module**"

Test optical light guides or lamps (see chapter 8 under "Service area - COOX module").

Remote Control

Remote Link (AVL OMNILink, Remote Control) is activated. ⇒ Exit Remote Link
(For users with password priority 1 only!)

Remote Lock

The AVL OMNI□ is locked by "Remote Link" (AVL OMNILink, Remote Control). ⇒ Disengage lock via Remote Link software (AVL OMNILink-Software) or at the AVL OMNI□.
(Possible with service password only!)

Sol 4 exhausted

The zero solution is no longer chemically active. pH-value of zero solution < 5. ⇒ Insert new zero solution.

tHb Temp Error

(AVL OMNI™ 2, 5 and 8 only

The following scenarios are built-up in a logical manner and are to be performed successively, until the error source has been identified.

Scenario 1:

Check tHb LED (see rear of analyzer, fourth LED from the left) and call up "**System - Test - Module Test - Voltages**".

LED lights up but the 5V or 12V is not OK?

no . **yes**

Power supply, Mainboard, Motherboard, electrical. connections interrupted ⇒ **Scenario 2**.

LED does not light up but the 24V is OK?

no . **yes**

- Temperature fuse defective ⇒ change tHb module (change see chapter 5).
- Electr. connection (**J9**) defective ⇒ change tHb module (change see chapter 5).

LED does not light up and the 24V is not OK?

no . **yes**

⇒ **Scenario 2**.

Call up "**System - Test - Component Test - Sensors - Temperatures**".

LED lights up, all voltages OK: Temperature too high?

no . **yes**

Change tHb module (change see chapter 5).

LED lights up, all voltages OK: Temperature too low.

- Electr. connection (**J9**) defective ⇒ change tHb module (change see chapter 5).
- Change Mainboard (change see chapter 5).
- Change Motherboard (change see chapter 5).

Scenario 2:

Check voltages on Motherboard with a DVM (Testpins, see chapter 5, "Checking the supply voltage and the reference voltage").

Reference voltage +/-2.5V not OK, but supply voltages +5V, +/-12V, +24V are OK?

no . **yes**

Change Mainboard (change see chapter 5).

Reference voltage +/-2.5V OK, but supply voltages +5V, +/-12V, +24V are not OK?

- Change Motherboard (change see chapter 5).
- DC cabletree (**J5**) defective (change see chapter 5).
- Power supply part defective ⇒ **Scenario 3**.

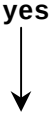
Scenario 3:

Check power fuse.

Fuse OK?

yes . **no**

Change fuse (change see chapter 5).



Power supply unit defective.

Change power supply (change see chapter 5).

Urea is defective
(AVL OMNI™ 7 to 9 only) See page 9-45.

Valve Overload (Applicable up to SN 5000; troubleshooting see chapter 10, under manual revision 8.0)

Error functions not identified by the software

Air bubble in sample path

Start measurement and check the filling process and recalibration. Switch On service report „**Aspiration & Conductivity**“ under “**System - Setup - Edit Reports - Service Report**”.

Aspiration status code 1 or 2?

no **yes**

Air bubbles develop in the measuring chamber ⇒ wetting problem.

Aspiration status code 3? (reference aspiration problem).

no **Yes**

- No more Reference solution available.
- Leaky tubing from the Ref. bottle to the Reference electrode.
- Ventilation aperture either not open or not open enough, Reference solution cannot be aspirated.

Aspiration status code 4.

Filling problem at the Junction ⇒ wet Junction and Junction tubing with blood.

Analyzer does not start up

The following scenarios are built-up logically and are to be performed successively, until the error source has been identified.

Scenario 1:

Analyzer is turned on.

Is there any reaction from the analyser? (Fan, LED voltages, floppy drive etc. not OK).

yes **no**

- Socket does not carry electricity.
- Power cable not properly connected or defective.
- Fuse defective.
- Power supply defective or short circuit in analyzer ⇒ **Scenario 2** (change power supply see chapter 5).

Check the LEDs for supply on the Mainbord.
5 V, 12 V or 24 V OK?

yes . **no**

At least one of the voltages is too heavily loaded ⇒ **Scenario 3**.

All voltages LEDs OK but screen remains dark?

no . **yes**

Problem with PC ⇒ **Scenario 4** (troubleshooting PC).

Some initial information on screen but bootprogram for controller is not started?

no . **yes**

Problem with PC / hard disc ⇒ **Scenario 5** (troubleshooting PC).

Bootprogram for controller is started but not properly ended.

Problem with controller or communication controller PC ⇒ **Scenario 6**.

Scenario 2: Problem with power supply or short circuit in analyzer.

Interrupt supply for µC part (disconnect **J5**) and turn analyzer on again.

Is the PC booting?

no . **yes**

One of the modules is causing a short circuit ⇒ connect **J5** again and determine the defective one by successively disconnected each module.

Disconnect thermal printer.

Is the PC booting?

no . **yes**

Thermal printer defective (change see chapter 5).

Disconnect all options (COOX, AutoQC).

Is the PC booting?

no . **yes**

Additional module defective.

Disconnect cabletrees on the power supply for PC and controller and check the output voltages of the power supply with DVM. Pinning see chapter 5 "Power supply unit".

All voltages OK?

no . **yes**

Problem in PC area ⇒ attempt to repeat and identify defective module with disconnected hard disc, floppy drive or PC motherboard.

At least 1 voltage not OK.

Power supply defective ⇒ change power supply (change see chapter 5).

Scenario 3: 5 V, 12 V or 24 V are not OK

Identify the defect module by disconnecting all modules successively.

Display LED for 5 V, 12 V and 24 V OK?

no . **yes**

The last disconnected module is defective and must be changed (change see chapter 5).

↓

All modules are disconnected. Display LED for 5 V, 12 V or 24 V not OK.

Error on Mainboard ⇒ change Mainboard (change see chapter 5).

Scenario 4: Problem with PC: Display remains dark.

Switch on analyzer.

Green LED on screen remains dark?

no . **yes**

Error in the voltage supply of the touch screen ⇒ check cable tree.

↓

Transmitter-LED on barcode scanner does not light up?

no . **yes**

- Barcode scanner is not connected.
- Barcode scanner is defective.
- Barcode control is defective or not connected (change see chapter 5).
- AVLIFB defective (change see chapter 5).
- PC board B486SLC defective (change see chapter 5).

↓

Memory test from PC is performed?

yes . **no**

Turn analyzer off and on again.[5]

↓

[5] PC's of type PCAT96 for AVL OMNI™ instruments SN < 1500 could have a reset problem, if not updated to Rev. 2.3. For lower revisions sometimes a turnoff – time of > 1 minute could be necessary. Update to Rev. 2.3! AVLIFB boards (PCAT96) EN0336 only (not applicable to EN0308 or EN0288) Rev. 7 have to be updated to Rev. >= 7.3 (power supply lines to thin, could be „blown").

Check access to floppy drive if not OK:

- Check cable connection to floppy drive.
- Change floppy drive (change see chapter 5).
- Change PC board B486SLC (change see chapter 5).

If all procedures up to this point have been unsuccessful ⇒ (if possible connect with an external monitor EXT-VGA):

Change screen (change see chapter 5).

Scenario 5: Program is not started.

One of the following information appears on the display:

„no System-Disk“?

no . **yes**

Hard disk defective ⇒ change hard disk[6] (change see chapter 5).

PC104 (SN 1500 – 2565):
„missing operating system“?

no . **yes**

- Check Setup if revision of PC is ≥ 4b.
- BIOS – hard disk parameters not correct.
- Hard disk defective ⇒ change hard disk (change see chapter 5).

AT96:
„GetDriveParameters“?

no . **yes**

No power supply.

AT96:
„Booting SysVue.....“?

no . **yes**

Data line interrupted or hard disk not formatted or defective ⇒ change hard disk (change see chapter 5).

[6] PC’s of type PC104 up to Rev. 4b are not equipped with an automatic HD detection feature. This was realized only from Rev. 5b onwards. In case of data losses of the built in CMOS-RAM the setup data of the HD have to be corrected and restored to EEPROM. (See also „MSDOS system can’t be read from the disk“). Update to Rev. 4b however avoids the CMOS data losses!

DOS is started successfully but the program is canceled with desired error information (e.g. "DOS4GW-error").

- Check Setup if revision of PC104 is ≥ 4b.
- Re-install software[7] (see chapter 8 under "Software update").

Scenario 6: Program is started but AVL OMNI□ does not reach warm-up.

Analyzer is turned on and all voltages are OK, PC boots and starts the program.

Message on screen:

comm. error reset omni

no **yes**

No connection from Mainboard to PC can be established.
Error in the cable connection (light gate) or problem on the Mainboard ⇒ **Scenario 7**.

Message on screen:

Modul: MC-Module
Process: Connecting
Status: Waiting for UC

The four LED's for communication PC-µP light up very brightly.

No connection between the modules can be established. Error in the cable connection (Optobus) or problem with measuring module, COOX module or T&D ⇒ **Scenario 8**.

Scenario 7: No connection main control to PC.

Check LED for the communication on the rear of the analyzer.

Transmitting-LED on the Mainboard lights up briefly approx. every 3 seconds?
(very brief lighting due to sign with 38kBaud).

no **yes**

Transmitter Mainboard OK.

[7] In case of power fails during operation (especially during data access / data writing to HD) files could be damaged. In this case a reloading or repair data of the AVL OMNI™-Software is recommended. (See „System not correct on HD or HD may have bad clusters“).

Transmitting-LED on Mainboard not OK?

no . **yes**

Error on Mainboard ⇒ **Scenario 9**.

Receiving-LED on PC lights in the same rhythm as the transmitting-LED on Mainboard?

no . **yes**

Data transfer from Mainboard to PC is OK.

Receiving - LED on PC remains dark?

no . **yes**

Problem with data transfer from Mainboard to PC ⇒ check light gate:

- Cable laying
- Check light gate for damage.
- Disconnect light gate on PC and check if a red flash is visible, if yes ⇒ error in receiving element from PC.

Transmitting-LED on PC lights in the same rhythm as transmitting-LED from Mainboard or receiving-LED from PC; access to the hard disk takes place at each light flash (error protocol)?

no . **yes**

PC receives data and responds properly.

Transmitter-LED on PC remains dark?

no . **yes**

- Error on PC ⇒ change AVLIFB (change see chapter 5).
- Change PC board B486SLC (change see chapter 5).

Receiving-LED on Mainboard lights in the same rhythm as transmitting-LED?

no . **yes**

Booting process should actually function.
Error on Mainboard (EPROM) or PC ⇒ install software again
(see chapter 8 under "Software update").

Receiving-LED on Mainboard remains dark.

Problem with data transfer from Mainboard to PC ⇒ check light gate:

- Cable laying
- Check light gate for damage.
- Disconnect light gate on PC and check if a red flash is visible, if yes ⇒ error in receiving element from PC.

Scenario 8: No connection to measuring module.

Analyzer is turned on.

D3 (Mainboard DIL switch HS) lights up simultaneously with D2 and D4?

no **yes**

Optobus is OK. Error lies on controller measuring module ⇒ **Scenario 9**.

D3 remains dark.

Optobus is interrupted at some place.
Be sure that a receiver is connected with a transmitter ⇒ check cabling.

Check T&D module:

- Check voltage supply.
- Jumper **J11** on T&D control (Components location see chapter 5) must not be set.

Check COOX module (optional):

- Check voltage supply.
- DIL switch **1** must be in the OFF position.

Check AutoQC module (optional):

- Check voltage supply.
- DIL switch **1** must be in the OFF position.

Attempt to short circuit Optobus directly on Mainboard.

D3 (Mainboard DIL switch HS) always lights at the same time with D2 and D4?

no **yes**

Error is located in one of the submodules ⇒ check again.
NOTE:
A module can also be bridged by disconnecting the transmitting and receiving line and by connecting the two photoconductors with another photoconductor directly.

D3 remains dark.

Error on Mainboard ⇒ change Mainboard (change see chapter 5).

Scenario 9: Problem on at least one of the two controllers on the Mainboard.

Remove rear panel and fan (see chapter 5).
Reset Mainboard (Reset key), listen to the summation ton and observe the LED's D31 and D5 (near µC186 and 135, respectively).
NOTE:
LED and summation ton are always activated at the same time, however, only one summation ton is present, which is driven by both controllers.

Immediately after letting the Reset key go, both LED's light briefly (either 1 or 2 times)?

no . **yes**

Bootprogram from the controller is properly started.

- LED blinks once - a program is loaded in the program memory.
- LED blinks twice - no program is loaded.

At least one of the two LED's remains dark?

no . **yes**

The respective controller cannot start the boot program.

- Check DIL switch **1** (If ON the CPU is put into a testmode and is deactivated to a greater extent.
- Check EPROM (version, poling).
- Check 5 V voltage with DVM.

After about 5-10 seconds, both LED´s light up briefly, once or twice?
However, if no sign is sent ⇒ error in transmitter diode area ⇒ change Mainboard (change see chapter 5).

no . **yes**

Checksum of the program is checked or a RAM test is performed.

- LED blinks once - a faultless program is loaded in the program memory.
- LED blinks twice - checksum is incorrect
  (program is properly corrected by the PC during next successful activation of "avstart").

At least one of the two LED´s remains dark.

Error on Mainboard ⇒ change Mainboard (change see chapter 5).

In case of problems with cold-start (=cold instrument) and a „warm-start“ seems to be successful: if PC104 (not PCAT96) is used, change PC104-board or update to Rev. 4b (exchange GAL).

MSDOS system can't be read from the disk. Hard disk may be defective or setup is incorrect.

For PCAT96:
An auto detection of the disk type for setup is implemented, therefore try to reboot the system with correct system floppy #1 and follow the directions on the screen.

For PC104 (SN 1500 – 2565) up to Rev.4b:
Connect a keyboard and check the setup-parameters. Read from the HD-label the counts for cylinders, heads and sectors (e.g. 988, 8, 52).
Reset the PC (or Off/On) and enter „setup“ by CNTRL/ALT/S when the appropriate message appears. Forward by up/down keys to the HD setups and correct if necessary.
If setup was correct, then HD will probably be defective.
If start procedure was not correct, start again and check if system comes up correctly. In this case you have to enter DOS and perform „storcmos“ by c:\util\chcksum nd c:\util\storcmos.
If you have to change HD, correct setup and perform „storcmos“ as mentioned above.

System not correct on HD or HD may have bad clusters.
Check HD with scandisk (c:\AVL\PC\scandisk) and follow the directions on the screen.
Bad clusters detected ⇒ change hard disk, try to repair only if you have no spare part.
Install a new system on hard disk with system floppies.

Background lighting defective

There are 3 different TFT-display types used in the OMNI:
- SN <1500: Display with 2 hot-cathode-tubes (EL0261)
- SN >1500: Display with 1 cold-cathode tube (EL0276)
- ~SN >2800: Display with 2 cold-cathode-tubes (EL0280)

EL0261

The lifetime is 5000 hours. Therefore the tubes have to be replaced every 6 months. During the lifetime the resistance of the heated (hot) cathodes increases and because of a constant current driving the power losses at the cathodes and with it the temperature increases and the insulation at the tubing ends may become too hot.

NOTE: *Always change both tubes at the same time, if one has become defective.*

EL0276

The display with the 1 cold cathode tube doesn’t have any problem with heating up the cathodes, on the other side the brightness and contrast is worse compared to the hot-cathode-tube display.
The lifetime is 10000 hours and this is defined as a decrease of the brightness to 50%. Thus, if the customer complaints a dark display, it is recommended to exchange the tube.

EL0280

This display is equipped with 2 cold cathode tubes with a lifetime of 25000 hours and even higher brightness (about 10% more than the EL0261).
The complete display module BP2274 (with EL0280) including mechanical parts and touch may replace the display module BP2050 (with EL0276).

Change of background lighting see chapter 5 under “PC components – Display”.

Barcode is not scanned in

The following scenarios are built up logically and are to be performed successively until the error source is identified.

Scenario 1:

Does the LED on barcode scanner light up?

no ↓ **yes** ⇒ **Scenario 2**.

LED on barcode scanner does not light up.

- Barcode scanner is not connected.
- Barcode scanner is defective.
- Barcode control is defective or not connected (change see chapter 5).

Scenario 2:

Call up for example:
"**System - Setup - Edit Reports - Set Hospital Name - Change Name**" and read in the barcode.

Barcode is not scanned in?

no ↓ **yes**

- Quality of the barcode is insufficient.
- DIL-switches on Barcode control are shifted (settings see chapter 5).

Barcode is scanned in improperly.

"Caps Lock" is activated on an external keyboard.

The scanning in of the respective barcode is answered with a beeping sound. If however, no listing on the screen takes place in the user program, the software interprets the scanned in barcode wrong; for example, "Caps Lock" key is pressed on an external keyboard.

BG/ISE/MSS/ tHb/COOX parameter(s) not calibrated

Press the corresponding parameter button(s) and a troubleshooting action list is displayed.

Delayed function key response

- Database too large ⇒ regular backup ⇒ delete database after backup.
- Turn on cache in BIOS (only for PC104; SN 1500 - 2565).

Avopto activated?

no **yes**

Press "**System - Util - Service Area - Switches 1**" and switch off "**AVOPTO Save**".

- Press "**System - Util - Service Area – Switches – Service Keyboard**" and switch to DOS to enter "**dbrep**" in the c:\AVL\PC directory. The index files are automatically recreated.
- Performing defragmentation in c:\DOS directory by entering "**defrag**"
  (Caution: defragmentation can take very long!)

Hard disk defective

Change hard disk (change see chapter 5).

ISE not calibrated

Scenario 1:

Call up „**Options - Reports - Electrode Status**“.

Slope Alarm?

no . **yes**

⇒ **Scenario 2**.

↓

1P Repro not OK?

no . **yes**

⇒ **Scenario 3**.

↓

1P Mean not OK?

no . **yes**

⇒ **Scenario 4**.

↓

1P No Sample?

no . **yes**

⇒ **Scenario 5**.

↓

1P Calc3?

no . **yes**

⇒ **Scenario 6**.

↓

Ref. aspiration problem?

no . **yes**

⇒ **Scenario 7**.

↓

For other errors refer to the respective error.

Scenario 2:

Slp: Mean not OK?

no . **yes**

⇒ **Scenario 8**.

Slp: 1P error?

no . **yes**

- Failed 1P calibration during last 2P calibration.
- Reported slopes are old and not reproduced.
- Try 2P calibration or analyze 1P calibration problem.

Repro, No Sample, No Ref. aspiration or calc3?

no . **yes**

See related 1P errors.

For other errors refer to the respective error.

Scenario 3:

1P: Repro not OK?

no . **yes**

⇒ **Scenario 9**.

Change respective electrode.

Scenario 4:

1P: Mean not OK?

no . **yes**

Reference electrode defective ⇒ change.

Change Electrode.

Scenario 5: 1P: No sample

Call up „**Options - Reports - Service Report - Repro & Quality**“

Electrode status flag always 13 on ISE?

no . **yes**

Reference aspiration problem ⇒ **Scenario 10**.

Watch wash and fill procedure during 1P calibration for bubbles after filling.

Last moment bubble?

no . **yes**

Try new FMS calibration or change PP tubes.

Check Cl electrode for obstruction.

Scenario 6: 1P: Calc. 3

Call up „**Options - Reports - Service Report - Repro & Quality**“

High SD’s on all parameters?

no . **yes**

⇒ **Scenario 11**.

- Electrode defective (air bubbles in the electrode itself).
- Amplifier defective.

Scenario 7: Reference aspiration problem

Call up „**Options - Reports - Service Report - Aspiration & Conductivity**“.
Check aspiration status code.

Reference pos. problem?

no . **yes**

Leak in measuring chamber:

- Junction Electrode
- Sealing
- Destroyed membrane.

Ref. line blocked or valve defective.

Scenario 8:

Slp: Mean not OK?

no . **yes**

Failed conductivity calibration or defective measuring chamber.

↓

Change electrode.

Scenario 9: 1P: repro not ok, on all parameters

Call up „**Options - Reports - Service Report - Electrode Potentials**".

Potentials of all parameters vary similar?

no . **yes**

Problem with reference system.[8]

↓

Na & K potentials different to Cl & Ca?

no . **yes**

Problem with target values.[9]

↓

Change electrode.

Scenario 10: Reference aspiration problem

Call up„**System - Util - Analyzer Actions - Fluid Actions - Fill Routines - Fill Reference Electrode**".

Check measuring chamber and left side for blockage or leakage.

Ref. aspiration OK?

no . **yes**

Check VII.

↓

Change measuring chamber cartridge, reseat electrode or remove blockage.

[8] If all potentials vary the same amount cycle to cycle, this is the indication for trouble with the reference system.
Reasons: Defective (drifting) Ref. electrode or lost connection between Ref and Na (bubble).

[9] If the variation are always vice versa between Na and Cl (Na and K similar but divers to Cl and Ca), this indicates unstable target values (failed conductivity measurement during 1P cycle)
Reasons: Obstruction in the sample path (very dirty Cl electrode or production failure of electrode sealing (hole not open completely) or very small bubbles due to wetting problems.

Scenario 11: High standard deviation on all parameters

Increasing SD's towards Ca?[10]

no . **yes**

Electric interference on the sample.[11]

↓

Ref. problem.[12]

Leaking out of reagents

An optical analysis of the fill level sensor and container pipes is recommended, by repeated leakage of the lower reagent plug.

Open bottle compartment and remove reagent bottles.

Fill level sensor bent or cracked?

no . **yes**

Change fill level sensors (change see chapter 5).

↓

Container pipe bent.

Adjust container pipe parallel to bottle compartment floor and to the fill level sensor.

[10] SD on K higher than Na, on Cl higher than K and Ca higher CL (=depending on distance to Ref), i.e.: Na 1.22, K 1.47, Cl 1.80, Ca 1.99

[11] Electrical interference: left side of sample path is not free:

- Shortcut to ground in R bottle (spillage): indicated by changing potentials in electrode test when Ref. tube is disconnected from pipe (behind bottles 1 to 4); the shortcut is also measurable with DVM between pipe and ground if the R bottle was not moved.
- Shortcut to ground in measuring chamber cartridge (leakage): indicated by changing potentials in electrode test when opening locking lever.
- Defective contact switch: indicated by changing potentials in electrode test when MCO or MCC is lifted.
- Shortcut to ground in the junction electrode tubing (theoretical possibility)

[12] Similar situation as described in note 8 on page 67. Here the interfering effect is faster (electrical noise, not drifts).
Reasons: Defective (drifting) Ref. electrode or lost connection between Ref and Na (bubble).

PO_2 not calibrated

Scenario 1:

Call up „**Options - Reports - Electrode Status**“.

0P Alarm?

no . **yes**

⇒ **Scenario 2**.

1P Calc1?

no . **yes**

Baro not calibrated.

1P Mean not OK?

no . **yes**

⇒ **Scenario 3**.

1P Repro not OK?

no . **yes**

⇒ **Scenario 4**.

1P Calc3?

no . **yes**

HW failure or SW < 2.06

See list of calibration flags, page 9-105.

Scenario 2: 0P alarm

0P Mean not OK?

no . **yes**

Change Solution 4 and start 2P O_2-calibration.[13]

0P Repro not OK?

[13] Solution 4 might be exhausted, even if there is still a lot of solution in the bottle. Change bottle by reading code, as only in this case the AVL OMNI™ flushes the aspiration tube to remove all exhausted solution. If there is no improvement, change electrode.

no . **yes**

Check for small air bubbles.[14]

Air bubble?

no . **yes**

Electrode doesn't fill with zero-solution (very high mVs) ⇒ wet electrode.

Solution 4 exhausted?

no . **yes**

pH-value of Solution 4 low ⇒ change Solution 4.
Remark: The pH cannot be measured by taking Solution 4 as a sample.

No zero-solution?

no . **yes**

Fill level counter low & aspiration error.[15]

See list of calibration flags, page 9-105

Scenario 3: 1P: Mean not OK

Baro OK?

no . **yes**

Electrode defective ⇒ change.

Baro not OK! ⇒ adjust baro settings (see chapter 8 under "Service area - Setup")

Scenario 4: 1P: Repro not OK

Call up „**Options - Reports - Service Report**".
Check history for analyzer startup, measuring chamber cover opened, electrode changed.

Any evidence of such actions?

no . **yes**

Drift due to interference.

Electrode defective ⇒ change.

[14] If the electrode doesn't fill properly during calibration: improve filling performance by wetting.

[15] **Attention:** aspiration errors might be due to chrystals on T&D disk!

PO_2 out of specs.

Scenario 1:

Wetting problem?

no . **yes**

Wet electrode.

↓

Air bubbles? (i.e. Combitrol Level 1: 120 mmHg instead of 60 mm Hg)

no . **yes**

Wet electrode.

↓

QC high (all levels) very often at first measurement?

no . **yes**

Failure at calculation of memory correction: Install SW > 3.3x or change electrode.

↓

QC sample handling OK?

no . **yes**

⇒ **Scenario 2**.

↓

- Storage temperature
- Equilibration

Scenario 2:

AutoQC?

no . **yes**

Bubble free aspiration? (Check in the glasstube).

↓

Sample type correct?

yes . **no**

Adjust.

↓

Check calibration database.

Unstable 1P values?

no . **yes**

⇒ **Scenario 4**.

↓

Scenario 3.

Scenario 3:

Upol OK?

yes . **no**

Adjust.

↓

Is the temperature of the measuring chamber, or measuring chamber cover OK ?

yes . **no**

Change measuring chamber.

↓

Moisture in sample inlet path, bypass nipple, V22 or SS1?

Check tubing for obstruction.

Scenario 4: Unstable 1P values

Corresponding Baro plausible?

no . **yes**

⇒ **Scenario 3**.

↓

Baro mV reading OK?

no . **yes**

Adjust Baro slope.

↓

Change Mainboard.

Sample not washed out in measuring module, sample path obstructed

Call up "**System** - **Util - Analyzer Actions - Fluid Actions - Wetting Electrodes - BG/ISE/MSS Electrodes**" and try to eliminate the obstruction with a syringe.

tHb/COOX: open all valves of the sample path (see tubing diagrams chapter 7) and proceed as listed below*.

* Procedure (see Fig. 7):

1. Replace the tube on the right of the tHb or COOX module with a tube placed in a container with deionized water (if available).
2. Remove tube from hemolyzer.
3. Using a syringe, draw the water through the module.

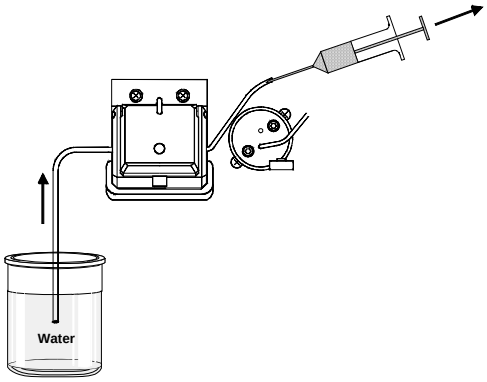


Fig. 7: Clog in the measuring module

NOTE: *Use the syringe only to aspirate and never to inject the water through the module, since the resulting overpressure could damage the measuring module!*

Avoid overpressure in all measuring chambers as well as tubing's!

Sample Sensor Error

Scenario 1:

Call up „**System - Test - Component Test - Sensors - Sample Sensors - Calibration**“.

Signal > 20 mV and current > 100 mA?

no . **yes**

⇒ **Scenario 2**.

Check optical path and optical coupling of sensors and clean it.

Sample sensor connected to Mainboard?

no . **yes**

⇒ **Scenario 3**.

Connect sample sensor.

Scenario 2:

Signal > 4000 mV and current < 40 mA?

no . **yes**

Change sample sensor or abrade a little bit the connector by means of a sandpaper.

Signal > 2500 mV and current > 250 mA?

no . **yes**

⇒ **Scenario 4**.

Scenario 3.

Scenario 3:

Sample sensor damaged or bent? Connector OK?

no . **yes**

Change sample sensor.

Change sample sensor and/or change Mainboard (Change see chapter 5).

Scenario 4:

Press „Measurement“ 10 times.

Difference within 1%?

no . **yes**

OK.

Restart with **Scenario 1**.

Software-Lockup

Software-lockups can be caused by any random interferences under simultaneous critical signal conditions at data access. „Once“ means less than once per week, and these lockups must be repairable by switching off and on the analyzer. In these cases we don’t recommend to exchange any hardware. (exception PC104 not updated to Rev. 4b => update necessary!).
Eventually an installation of an UPS (uninterruptable power supply) should be done.

Scenario 1:

Switch instrument off and on again.

Display shows no test picture after startup?

no . **yes**

PC OK! Communication to µC-Mainboard defective: check connection and Mainboard.

Instrument function not OK?

no . **yes**

⇒ **Scenario 2**.

⇒ **Scenario 3.**

Scenario 2:

Reinstall software and check again.

Failure not reoccurring?

no . **yes**

⇒ **Scenario 3**.

Lockup in DOS?

no . **yes**

Check PC hardware.[16]

DOS-commands are working?

no . **yes**

- Check software installation again.
- Check harddisk.

Check PC-hardware.

Scenario 3:

Barcode reading problems?

no . **yes**

Check the following points:

- Contrast of barcode OK?
- Clear and readable barcode (original barcode)?[17]
- Keyboard connected?[18]
- Keyboard permanently pressed (e.g. box on keys)?

Reinstall software and check again.

Touch screen defective

Change touch screen (change see chapter 5).

[16] In case of lockups in DOS under messages like „DOS4GW error...“ check if there is used a PC104 in the failing instrument, then update PC104-board to Rev. 4b.

[17] Barcodes must be good readable and contrast should be OK. The codes must not be dirty or glued with a transparent gluing-stripe.

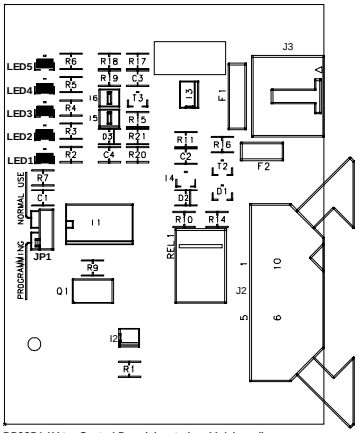
[18] In case of a connected keyboard press once the „ALT“ key respectively check if the control-LED’s for „NUM-LOCK“, „CAP’s lock“ are inactive.

Valve problems

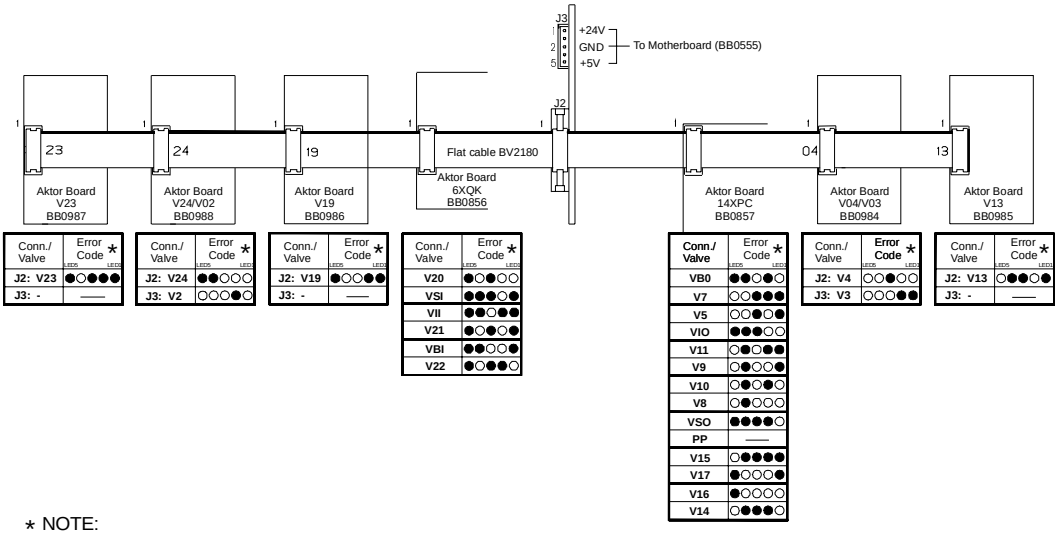
From SN 5000 on (linear actuators)

10 attempts are made to actuate a valve via the Aktor Control Board. If in case of malfunction, no response occurs, the LED's on the Aktor Control Board signal the defective valve (see Fig. 8). The respective LED remains illuminated until another valve is actuated (e.g. during valve test or as part of a program routine).

LED's signal only malfunctions during data transmission or in the electronics, but not errors due to mechanical causes.
Proper switching of the valves (e.g. motor does not skip) must also be verified by a visual and audible test of the switching procedure.



BB0854 (Aktor Control Board, located on Mainboard)



* NOTE:
Error code LED1 to 5 are located on Aktor Control Board (BB0854)

● Active

○ Not active

Fig. 8: Valve error codes

NOTE: *Jumper **J1** must be set to "**NORMAL USE**".*

Waste Sensor Error

Call up „**System - Test – Component Test - Sensors – Fill Level Sensors**“.

Check optical path and optical coupling of waste cap 1 & 2 and clean it.

Waste cap 1 & 2 revision < 3?

no . **yes**

Upgrade!

All filling level values < 20 mV?

no . **yes**

- Check connection of waste cap 1 and Fill Level Board or change it (bad contact?).
- Change Mainboard.

Remove waste bottle.

Filling level < 3000 mV?[19]

no . **yes**

Change waste cap 2.

Tip the waste sensor 2 into a glass of water.

Filling level < 300 mV?

no . **yes**

OK

Change waste cap 2.

[19] The detection level for the software for air must be > 500 mV, for water < 500 mV. If the recommended values are maintained, functionality is ensured.

Wrong measurement values

This troubleshooting refers to reproducible measurement errors and not to single measurement deviations.

The following scenarios are built-up logically and are to be performed successively, until the error source has been identified.

Scenario 1:

Check sample type on the measurement protocol.

Is the sample type correct?

no . **yes**

⇒ **Scenario 2**.

↓

Wrong declaration by the user during sample input.

Scenario 2:

Check settings under "**System - Setup - Correlation**".

Are individual settings programmed in?

no . **yes**

Settings are not correct.

↓

⇒ **Scenario 3**.

Scenario 3:

First differentiation:
Which parameters are measured incorrectly?

- pH, PCO_2 and/or ISE ⇒ **Scenario 4**.
- O_2 ⇒ **Scenario 5**.
- tHb ⇒ **Scenario 8**.

Scenario 4: pH, pCO2 and/or ISE

Second differentiation:
Which FMS calibrated parameters are measured incorrectly?

pH and PCO_2 and all ISE?

no . **yes**

Error in commonly used systems:

- Sample path is not washed/dried or oversalted since Solution B was used instead of Solution A.
- FMS reagents:
  The wrong barcodes were scanned in during the last B&C bottle change.
  Expiration date from B&C was exceeded, or incorrectly stored B&C bottles are used.
- FMS:
  Mixing valves not completely sealed on some side (FMS false calibration).

pH and PCO_2?

no . **yes**

Module specific error:

- Temperature error due to defective BG measuring chamber cover heating ⇒ change measuring chamber cover (change see chapter 5).
- Temperature error due to defective BG measuring chamber heating ⇒ change BG measuring chamber (change see chapter 5).
- Concentration error in the Reference solution FMS false calibration for BG.

All ISE?

no . **yes**

Module specific error:

- Temperature error due to defective ISE measuring chamber cover heating ⇒ change measuring chamber cover (change see chapter 5).
- Temperature error due to defective ISE measuring chamber heating ⇒ change BG measuring chamber (change see chapter 5).
- Concentration error in the Reference solution FMS false calibration for ISE.

pH or PCO_2 or single ISE-parameters.

- Electrode dirty ⇒ see Operators's Manual, chapter 9, "Maintenance", section "External Cleaning of the Measuring Chambers".
- Electrode defective (change see Operators's Manual, chapter 9, "Maintenance").

Scenario 5: O_2

Call up "**System - Test - Component Test - Sensors - Barometer**" and check the displayed barometric pressure.

Is the displayed value incorrect ?

no

yes

- Wrong 1P calibration of the barometer ⇒ set actual air pressure (see chapter 8, "Util - Service area - Setup - BP set").
- Wrong slope characteristic value of the barometer ⇒ set correct characteristic value (see chapter 8, "Util - Service area - Setup - BP set").
- Barometer defective ⇒ change Mainboard (change see chapter 5).

⇒ **Scenario 6**.

Scenario 6:

Call up "**System - Util - Service Area - Setup - O2-UPol**" and check the set value.

Is the set value wrong?

no

yes

Correct setting (see chapter 8, "Util - Service area - Setup - O2-UPol").

⇒ **Scenario 7**.

Scenario 7:

Check the air-aspiration tube in the bottle compartment, and the T&D position 3 for free passage.

Is the air aspiration path blocked?

no

yes

- T&D disc is clogged in Pos.3.
- T&D tubing set in tube Pos.3 is clogged.
- Tube in the bottle compartment is clogged.

The air aspiration path is free.

- Measuring chamber temperature error.
- Electrode dirty ⇒ see Operators's Manual, chapter 9, "Maintenance", section "External Cleaning of the Measuring Chambers".
- Electrode defective (change see Operators's Manual, chapter 9, "Maintenance").

Scenario 8: tHb

Check tHb sample path including cuvette for excess water or sample (AVL OMNI™ 2, 5 and 8 only).

Excess water in the sample inlet path?

no . **yes**

- Dry path over bypass cartridge and V23 partially clogged/narrowed.
- Leakage in vacuum system.

Excess water in the tHb module?

no . **yes**

Dry path over V4 air, tHb module, V2 and V23 partially clogged/narrowed.

Any remnants of dry sample in sample inlet path?

no . **yes**

The sample inlet path is not washed (Solution A is not aspirated over the backpressure valve, heating pipes in the sample distributor and T&D Pos.2 through the sample inlet path).

Any remnants of dry sample in the tHb module?

no . **yes**

tHb module is not washed (Solution A is not aspirated over V3 and V4 through the tHb module and over V2 and V23 into Waste).

No excess water, sample path dry.

⇒ **Scenario 9**.

Scenario 9:

tHb calibrator measured (diluted) (AVL OMNI™ 2, 5 and 8 only).

Same error as by measurements of blood occurs?

no **yes**

- Calibration error (wrong sample type given during calibration, wrong final value given in).
- Leakage of water supply over V3/ V4 (air bubbles are aspirated with water into the cuvette during reference measurement).
- Water supply over V3/V4 is hindered (ventilation of Solution A is not given, tube pinched).
- Cuvette does not fill.
- Cuvette dirty.
- tHb temp. error (see page 9-51).

Final value is measured (Error only by measurements of blood).

- Hemolysis not complete ⇒ hemolyzer defective (change see chapter 5).
- Interference filter defective (change see chapter 5).

Service report

General

The service report of the AVL OMNI™ consists of 6 reports, which can be assigned to the following problem areas:

- aspiration problems
- conductivity problems
- temperature problems
- alarms, Optobus errors
- repro problems, calc 3, mean
- electrode signal quality
- FMS problems
- electrode potentials

The service report can be activated on-line, which means that the activated report will be printed after each measurement or calibration, or is printed later on with the aid of a separate activation function.
A service report can be generated for up to 4 days after the respective service activity was performed (for more information see Section "Activation of reports, page 9-87).
The data is stored by the day, and when a new file is created, the previous, 4-day file will be overwritten.
Currently 6 types of reports are available which can be activated/printed individually.

Report structure

Each report consists of up to 3 header lines, the data lines and one footer line.

General structure:

Header lines 1 - 3: e.g.:

K1: Designation (e.g. Cal., M., Wash, ...), date, time

K2:	Aspiration Status				Conductivity				Aspiration Temp		
K3:	BG	ISE	MSS	tHb	BG	ISE	MSS		BG	ISE	MSS

Information lines: e.g.:

IL: Cycle name (=six pack), aspiration status code / module, conductivity value in mV / module, alarms, Optobus errors[20]

Footer line:

End (time, FMS time[21], *P*CO2 NE correction value with electrode status [22], MSS-Counter[23])

Additional information:

Empty Ref, Flush Ref, MSS SOL_D

[20] interpretation see next page
[21] description see page 9-109
[22] report 3 only
[23] report 5 and 6 only

Designations in header line 1	
System	System calibration
1P spec.....	1P calibration with PO_2 air calibration
2P spec.....	2P calibration with PO_2 2P calibration
1P Cal	1P calibration without PO_2 air calibration
2P Cal	2P calibration without PO_2 2P calibration
1P O2.....	PO_2 air calibration
2P O2.....	PO_2 2P calibration
1P2 Cal	1P calibration with PO_2 air calibration and 2P calibration MSS
Mixing	Conductivity calibration
tHb	tHb calibration
Meas.	Measurement
Wash.....	Washing and recalibration
Clean	Manual cleaning
Cond.	Manual conditioning

Meas. cycle	Cal. cycle	others	Cycle designation in information line	
•			M.....	Measurement (QC measurement)
	•		1P	Aspiration cycle of 1P calibration
	•		1P(C)	Aspiration cycle of 1P calibration with determination of PCO_2 correction
	•		2P	Aspiration cycle of 2P calibration
	•		N	Recalibration cycle
	•		NCO	Recalibration after 02 air with PCO_2 correction
	•		Quick.....	Recalibration aspiration cycle with preparation of subsequent cycle
		•	Air.....	PO_2 air calibration
•			Zero.....	PO_2 zero point calibration
		•	LFB	Conductivity cycle with Solution B
		•	LFC	Conductivity cycle with Solution C
			<E>.....	Alarms and system stops
	•		D	Aspiration cycle of MSS Ref. calibration with Sol. D
		•	dD	Finish of section of the MSS Ref. calibration
•			C1.....	Aspiration cycle of 1P calibration MSS with Sol. 5
•			C2.....	Aspiration cycle of 2P calibration MSS with Sol. 3
•			C3.....	Aspiration cycle of Int/1P/Slp calibration with Sol. 1
				(see next page)

Remark: *Aspiration Status Codes (ASC) for Solution 1, 3, 4 and 5 (solutions aspirated through the T&D module) can be found in Table 3 on page 9-104.*

<!> ..... Optobus errors (detailed description see chapter 8 under "Optobus"):

	Lost messages	HW instabilities	Reinitializing	Solved failures	Module error (1)	Module error (2)
Optobus Error Counter : (e.g.)	**0**	**0**	**1**	**0**	**0**	**0**

Module error (1) indicates that a certain module is currently not accessible.
Module error (2) indicates that a certain module was not accessible once since the startup of the AVL OMNI™.

The following applies:

Measurement control module	**1**
COOX module	**2**
AutoQC module (option)	**3**
T&D module	**4**

Example: an optobus error counter of **0 0 1 0 4 0** means that the T&D module is currently not accessible.

Clean ..... Autom. cleaning
Cond. ..... Autom. conditioning (Solution 2)

Footer line

Stby ..... Standby, system is ready for other functions

The columns printed on the report depend on the device type. If a certain module is not present, the corresponding line is omitted. A "-" entry means, that the respective parameter was not involved in the current action.

Additional information :

<!> *Empty Ref* — 2 minutes after each measurement, calibration or wash cycle, air is aspirated into the measuring chamber via the Junction electrode, preventing mixing of calibration solution and KCl.

<!> *Flush Ref* — 15 minutes after each measurement, calibration or wash cycle, the Reference electrode is flushed with KCl to ensure that the reference system remains air bubble-free.

<!> *MSS SOL_D* BSA LA GL NH K UR (reference point potentials)

The MSS sensor is rinsed with Solution D to prevent sensor damage (preventing enzyme migration) during

- 1st phase after sensor insertion,
- during system stops,
- economy mode.

The intervals depend on how long the MSS cassette is used in the instrument:

GLU/LAC:

- 0 - 2h: every 5 minutes
- 2 - 24h: every 15 minutes
- 24 - ∞h: every 60 minutes

GLU/LAC/UREA:

- 0 - 2h: every 5 minutes
- 2 - ∞h: every 10 minutes

Activation of reports

Reports can be activated and deactivated on a separate screen, which is also accessible to the user.
The "**System - Setup - Edit Reports - Service Report**" menu calls up a screen with 6 keys (On/Off). You can use these keys to activate one or more service reports, which will then be printed with each measurement and calibration report.

The printout of service reports for a randomly selectable period of time is activated in the "**Options - Reports - Service Report**" menu, which again pulls up a screen with 6 keys. In addition, a time window can be set for the printout. The default value is "Complete history", which generates a printout covering the preceding 4 days.

Description of reports

1st Report (Aspiration and Conductivity)

Printout under: "**Options - Report - Service Report**".

Displays aspiration problems, conductivity, temperatures and alarms.

HL1: Designation (e.g. Cal., M., Wash, Fill Ref., ...), date, time
HL2: Aspiration Status Conductivity Aspiration Temp
HL3: BG ISE MSS tHb BG ISE MSS BG ISE MSS
IL: Cycle name (=six pack), aspiration status code / module, conductivity value in mV / module (MCC-MCO), diff temp. / module, alarms, Optobus errors

Aspiration problems:

A description of the flags that may occur during aspiration of a sample or calibration solution (1, 3, 4 and 5) via T&D module, can be found in Table 3 on page 9-104.
A description of the flags that may occur during aspiration of calibration fluids can be found in Table 6 on page 9-108.

Conductivity:

In the BG and ISE module, the conductivity between the Junction electrode and the right side MC electrode holder is measured for the calculation of mixing ratios. With LFB and LFC, the conductivity of the individual reagents is measured.
In the MSS module, the conductivity between MCO (**RCon**) and MCI (cooling block) is measured and used for positioning.
Limits and typical values can be found on page "Calibration Parameter Limits", page 9-110.

Temperatures:

An aspiration temperature difference exceeding **+/-0.25 °C** (abs.) results in deviations in the conductivity measurement and an incorrect calculation of the desired value.
Note: greater aspiration temperature differences of approx. -0.3 °C are common after washing the sample distributor.
In the MSS measuring chamber, the temperature can be detected via NTC in the contact clip and provides information on the temperature stability of the MSS cassette.
Typical values are between 25.0 °C and 27.0 °C.
A "-" means that during this calibration, the current position could not be updated.

For example:

AVL OMNI
Service Report
Aspiration & Conductivity

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

Meas. 29.05.1998 10:38

	Aspiration Status				Conductivity			Aspiration Temp		
	BG	ISE	MSS	tHB	BG	ISE	MSS	BG	ISE	MSS
<!>	Optobus Error Counter : 0 0 1 0 0 0									
<E>								10:40 Fill Levels		
M	0	1	0	-	-2500	0	386	-0.05	-0.05	-
N	0	0	-	-	1578	1058		-0.19	-0.14	-
D	-	-	0	-	-	-	802	-	-	26.42
dD	-	-	-	-	-	-	-	-	-	-
1P	0	0	-	-	1574	1054	-	-0.07	-0.08	-
Stby		10:40		FMS: 0.78						
<!>	MSS SOL_D : 30.25 29.95 26.21 334.44 227.78 371.52									
<!>	Empty Ref									
<!>	Flush Ref									

Explanation:

At 10:38 a.m., a status 1 occurred for ISE during sample aspiration. According to Table 3, page 9-104, this means "sample pos. error" on the measurement report.

2nd Report (Repro & Quality)

Printout under: "**Options - Report - Service Report**".

Displays Repro, Ca1c 3, mean, electrode quality:

HL1: Designation (e.g. Cal., M., Wash, ...), date, time
HL2: Electrode Status Flag Standard Deviation (Calc)
HL3: pH O2 CO Na K Cl Ca pH O2 CO Na K Cl Ca
IL: Cycle name, calibration flag / parameter, standard deviation of precalculation / parameter, alarms, Optobus errors

Measurement/Calibration flag by parameter:

pH, *P*O2, *P*CO2, Na, K, Cl, Ca
Electrode status according to Table 2 and 4 (Electrode Status Flag), see page 9-99 and 9-107.

Standard deviation of precalculation by parameter:

pH, *P*O2, *P*CO2, Na, K, Cl, Ca
The standard deviation of the precalculation gives information on the signal quality of the adjustment curve of the electrode potentials (typical values are < 0.2 (pH < 0.5) and is a decisive criterion on whether a precalculation can be performed.

A "-" means that during this calibration, the current position could not be updated.

For example:

AVL OMNI
Service Report
Repro & Quality

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

Meas. 29.05.1998 10:38

	Electrode Status Flag							Standard Deviation (Calc)						
	pH	O2	CO	Na	K	Cl	Ca	pH	O2	CO	Na	K	Cl	Ca
<!>	Optobus Error Counter : 0 0 1 0 0 0													
<E>												10:40 Fill Levels		
M	0	0	0	81	81	81	81	0.05	0.04	0.22	0.93	2.41	3.12	11.76
N	0	-	9	0	0	0	0	0.02	0.02	0.21	0.07	0.01	0.15	0.60
D	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1P	0	-	0	0	0	0	0	0.03	0.04	0.17	0.11	0.06	0.04	0.02
Stby			10:40			FMS: 0.78								
<!>	MSS SOL_D : 30.25 29.95 26.21 334.44 227.78 371.52													
<!>	Empty Ref													
<!>	Flush Ref													

Explanation:

At 10:38 a.m., a status 81 occurred during sample aspiration regarding parameters Na, K, Cl and Ca.
According to Table 2, page 9-99, this means "sample pos. error".

During the aspiration cycle of the recalibration, a flag 9 occurred for CO.
According to Table 4, page 9-107, this means "*P*O2 recalibration difference too great" or the printout "NE-Diff. nOk" on the electrode status report.

3rd Report (Electrode pot.)

Printout under: "**Options - Report - Service Report**".

Displays electrode potentials, standard deviation of the calibration values:

HL1: Designation (e.g. Cal., M., Wash, ...), date, time
HL2: Potential Standard Deviation
HL3: pH O2 CO Na K Cl Ca pH O2 CO Na K Cl Ca
IL: Cycle name, six pack value 1 / parameter, standard deviation / parameter, alarms, Optobus errors

Six pack value l (measured value):

The latest valid calibration value is displayed for each parameter. In the 1P calibration, this is the basic potential, in the 2P calibration, the slope, and in a measurement, it is the measured value.
Limit and typical values can be found on page 9-110, "Calibration Parameter Limits".

Standard deviation of calibration values by parameter:

For limit values, page 9-110, "Calibration Parameter Limits".
High standard deviations for all parameters in one measuring chamber indicate a reference problem.
Standard deviations increasing with the distance to the reference electrode, indicate crosscurrents. Increased values for just one electrode may indicate a bad electrode.

***P*CO2 - NE correction value (dC02) and status:**

This value is an evaluation criterion for the *P*CO2 electrode and represents the mean value of the difference potentials at calibration after the air calibration to the actual value of the 1P calibration.

A "-" means that during this calibration, the current position could not be updated.

For example:

AVL OMNI
Service Report
Electrode Potentials

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

Meas. 29.05.1998 10:38

	Potential							Standard Deviation						
	pH	O2	CO	Na	K	Cl	Ca	pH	O2	CO	Na	K	Cl	Ca
<!>	Optobus Error Counter : 0 0 1 0 0 0													
<E>										10:40 Fill Levels				
M	381	324	-891	1049	374	665	460	-	-	-	-	-	-	-
N	385	-	-906	1058	420	714	674	2.2	-	0.0	0.6	1.6	1.0	1.9
D	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1P	386	-	-896	1055	417	717	671	1.1	-	0.5	0.6	0.4	0.6	0.7
Stby			10:40			FMS: 0.78				dCO2: -8.2 (0)				
<!>	MSS SOL_D : 30.25 29.95 26.21 334.44 227.78 371.52													
<!>	Empty Ref													
<!>	Flush Ref													

4th Report (FMS parameter)

Printout under: "**Options - Report - Service Report**".

Displays information on the FMS:

HL1: Designation (e.g. Cal., M., Wash, ...), date, time
HL2: FMS
HL3: %CBG %CISE Mix
IL: %C-module / module, %C-FMS, alarms, Optobus errors

FMS:

- Information on the FMS time
- Electronic mixing ratio (mixing valve) ... mix
- Actual mixing ratio of each module ... %CBG, %CISE

The FMS post aspiration time (see also "Interpretation of the FMS times", page 9-109) provides information on how long the calibration solution has to be aspirated (longer or shorter than normally necessary) into the sample distributor to be in the right position for V21 (depending on Peristltic pump pump tubing and container pipe tolerances). Times exceeding these values cause FMS volume error (see page 9-7).

The difference between electronic and actual mixing ratio should not exceed +/-4% [e.g. 32%(BG) 32%(ISE) 39%(MIX) = a deviation of 7%], since otherwise problems with the position of the calibration points could occur. The default (MIX) must not be outside 27% (54%) or 39% (66%). lf the result (%CBG, %CISE) deviates from the desired value by more than +/-8%, a FMS error occurs (see page 9-4).

A "-" means that during this calibration, the current position could not be updated.

For example:

AVL OMNI
Service Report
FMS Parameter

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

```
Meas.       29.05.1998  10:38
               FMS
     %CBG  %CISE  %Mix
<!>  Optobus Error Counter : 0 0 1 0 0 0

<E>                                                  10:40 Fill Levels
M       -       -       -
N   32.89   34.77   39.00
D       -       -       -
dD      -       -       -
1P  33.10   34.01   39.00
Stby        10:40        FMS: 0.78

<!>         MSS SOL_D : 30.25  29.95  26.21  334.44  227.78  371.52
<!>         Empty Ref
<!>         Flush Ref
```

5th Report (Repro & Qual. MSS)

Printout under: "**Options - Report - Service Report**".

Displays Repro, Ca1c 3, mean, electrode quality:

HL1: Designation (e.g. Cal., M., Wash, ...), date, time
HL2: Electrode Status Flag Standard Deviation
HL3: BS LA GL NH K UR LF BS LA GL NH K UR
IL: Cycle name, calibration flag / parameter, standard deviation of precalculation / parameter, alarms, Optobus errors

Measurement/Calibration flag by parameter:

BSA, Glu, Lac, NH_4, K, UREA
Electrode status according to Table 2 and 4 (Electrode Status Flag), see page 9-99 and 9-107.

Standard deviation of precalculation by parameter:

BSA, Glu, Lac, NH_4, K, UREA
The standard deviation of the precalculation gives information on the signal quality of the adjustment curve of the electrode potentials (typical values are < 0.2 and is a decisive criterion on whether a precalculation can be performed.

The MSS counter displays the usage time of the MSS cassette in seconds.

A "-" means that during this calibration, the current position could not be updated.

For example:

AVL OMNI
Service Report
Repro & Quality MSS

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

Meas. 29.05.1998 10:38

	Electrode Status Flag							Standard Deviation (Calc)					
	BS	LA	GL	NH	K	UR	LF	BS	LA	GL	NH	K	UR
<!>	Optobus Error Counter : 0 0 1 0 0 0												
<E>												10:40 Fill Levels	
M	0	0	0	11	11	11	0	-	-	-	-	-	-
N	-	-	-	-	-	-	-	-	-	-	-	-	-
D	0	0	0	0	0	0	0	0.14	0.22	0.06	0.05	0.06	0.05
dD	0	0	0	0	0	0	-	-	-	-	-	-	-
1P	-	-	-	-	-	-	-	-	-	-	-	-	-
Stby			10:40			FMS: 0.78				MSS-Counter: 931522			
<!>	MSS SOL_D : 30.25 29.95 26.21 334.44 227.78 371.52												
<!>	Empty Ref												
<!>	Flush Ref												

Explanation:

At 10:38 a.m., a status 11 occurred during sample aspiration regarding parameters NH, K and UR.
According to table 4, page 9-107, this means "Calc 3".

6th Report (Electrode Pot. MSS)

Printout under: "**Options - Report - Service Report**".

Displays electrode potentials, standard deviation of the calibration values:

HL1: Designation (e.g. Cal., M., Wash, ...), date, time
HL2: Potential Standard Deviation
HL3: BS LA GL NH K UR BS LA GL NH K UR
IL: Cycle name, six pack value 1 / parameter, standard deviation / parameter, alarms, Optobus errors

Six pack value l (measured value):

The latest valid calibration value is displayed for each parameter. In the MSS Ref. calibration, this is the basis potential, for the MSS Int/1P/Slp calibration, it is the respective slope.
Limit and typical values can be found on page 9-110, "Calibration Parameter Limits".

Standard deviation of calibration values by parameter:

For limit values, page 9-110, "Calibration Parameter Limits".

A "-" means that during this calibration, the current position could not be updated.

For example:

AVL OMNI
Service Report
Electrode Potentials MSS

29.05.1998 10:59 Serial Number: 2393

Range: 29.05.1998/10:29 - 29.05.1998/10:59

Meas. 29.05.1998 10:38

	Potential						Standard Deviation					
	BS	LA	GL	NH	K	UR	BS	LA	GL	NH	K	UR
<!>	Optobus Error Counter : 0 0 1 0 0 0											
<E>										10:40 Fill Levels		
M	10	623	1004	12	-17	98	-	-	-	-	-	-
N	-	-	-	-	-	-	-	-	-	-	-	-
D	34	53	38	182	193	187	0.8	0.6	1.2	2.7	1.1	1.9
dD	34	51	37	182	193	187	0.9	3.6	2.6	3.0	1.8	2.9
1P	-	-	-	-	-	-	-	-	-	-	-	-
Stby	10:40			FMS: 0.78			MSS-Counter: 931522					
<!>	MSS SOL_D : 30.25 29.95 26.21 334.44 227.78 371.52											
<!>	Empty Ref											
<!>	Flush Ref											

MSS status during polarization

Situation	Message Window	Data Manager	Electrode Status	Service Report	Actions
Polarization terminated with "no sample"	MSS polarization not ok	Wait for Cal.	No sample (Pol)!	Status 37 MSS polarization not OK 5	Press "Options – MSS Pol."
First evaluation terminated because of aspiration problems	MSS polarization not ok	Wait for Cal.	Pol. cancelled!	Status 39 MSS polarization not OK 6	Check aspiration of Sol. D (R3 for urea) and Sol. 3
First evaluation Glu, Lac or Urea negative: before first calibration	Glu is defective/ Lac is defective/ Urea is defective	Wait for Cal.	Polarizing!	-	Replace MSS cassette
First evaluation Glu, Lac or Urea negative: after first calibration	Glu is defective/ Lac is defective/ Urea is defective	e.g. Mean nOK	e.g. Mean nOK	28	Replace MSS cassette
First evaluation BSA negative: before first calibration	Glu is defective/ Lac is defective	Wait for Cal.	Polarizing!	-	Replace MSS cassette
First evaluation BSA, NH4 or K negative: after first calibration	Glu is defective/ Lac is defective/ Urea is defective	e.g. Ifs Mean nOK	e.g. Ifs Mean nOK	78	Replace MSS cassette
Open MC cover during polarization	MSS polarization not ok	Wait for Cal.	Pol. cancelled!	Status 39 MSS polarization not OK 4	Remove alarm
Polarization cancelled; temp. alarm; MC cover open, Sol. 3 or D empty during polarization	MSS polarization not ok	Wait for Cal.	Pol. cancelled!	Status 39 MSS polarization not OK 3	Remove alarm
Sensor polarized (in alarm); AVL OMNI™ ready	Polarizing	Wait for Cal.	Polarizing!	38	Everything ok: please wait

List of measurement flags

List and interpretation of flags occurring in the AVL OMNI™ **during measurement**. Described in service report under "**Options - Reports - Service Report - Repro & Quality**".

List of all flags that may occur during measurement:

Flag	Description	Text[24]
6	Calculation error 1 (UC)	calc. 1
11	No or invalid precalculation	calc. 3
14	MSS reference value invalid (flag > 0)	Reference not OK
21	Temperature alarm	temp. error
26	ADC hardware problems	ADC HW error
29	ADC overflow	>>>>>
30	ADC underflow	<<<<<
39	Parameter in alarm (signed with a black cross)	not calibrated
50	Wave length calibration in process	SW error
51	Cannot calibrate due to hardware problems	HW error
59	Error with Slave (CCD processor) during calibration	com. error
60	Calculation error 6	calc. 6
61	COOX module does not detect blood or similar sample	Interference's
62	Wave lengths not calibrated	not calibrated
64	Measurement performed by PC or UC despite layer thickness not calibrated. **For development only!**	MCFL 64
72	Calculation error 1 from an interference sensor	IfS Calc.1
75	Invalid precalculation from an interference sensor	IfS Calc.3
76	Interference sensor reference point not OK	Ifs Ref. not OK
77	ADC hardware problem at an interference sensor	IfS ADC HW Error
79	ADC overflow at an interference sensor	IfS >>>>>
80	ADC underflow at an interference sensor	IfS <<<<<
81	No stable conductivity value detected	sample pos. error
82	No air segment between calibration and measurement	sample sep. error
83	General KCL aspiration problem	Ref. Sol asp. error
84	General KCL positioning problem	Ref. Sol pos. error
85	SS1 detects the end of the sample, but the measuring chamber is not completely filled	End of sample det.
86	Ratio between long and short contact path is not OK	Irregular sample
87	No direct effect on BG/ISE (information for combination SS1 no /SS2 yes)	MCFL 87
88	No direct effect on BG/ISE (information for combination SS1 no /SS2 yes)	no sample detected
89	No sample detected after module is filled	no sample detected
90	No sample detected after module is filled	no sample detected
91	No direct effect on BG/ISE (information for combination SS1 no /SS2 yes)	insufficient sample
92	Sample volume too small	insufficient sample
93	Sample distribution problem (SS2 yes / SS1 no or SS2 yes / SS3 no)	sample distr. error
94	Sample container attached. No sample detected by SS2.	no sample in VSS
95	Insufficient sample volume detected in MSS module (SS4 no, while separating air bubble is in sensor)	insufficient Sample
100	Sample could not be aspirated to SS4 in the sample distributor	Distr. Error MSS
101	tHb/COOX sample detection not possible	Cuvette Not OK
102	No signal change for detection of sample beginning	no sample detected
103	No stable signal	sample pos. error
120	It was not possible to build up a sufficient vacuum during AQC measurement	
121	AQC sensor could not detect sample	

Table 2: List of measurement flags

[24] Display in measurement report under "**System - Setup - Edit Reports - Measurement Report**".

Measurement value flags

Flag	Description	Text[25]
--	Parameter is deactivated (black X) or not activated (gray).	not selected
--	Parameter is in alarm status (red X).	not calibrated
--	The tHb-cuvette has not been calibrated for 99 days	*
--	Sample type no longer applies to corresponding parameter	?
--	Hct value impaired by electrolyte balance	#
--	The set normal range was exceeded for one measurement value	(+), (-)
--	The set critical range was exceeded for one measurement value	(++), (--)
--	Waiting for data link aborted	no data
--	Limiting values for Glu (<0,5 mmol/l), Lac (<0,0 mmol/l), Urea (0,0mmol/l) will be checked	Improper sample
--	Limiting values for Glu (>100 mmol/l), Lac (>100 mmol/l), Urea (>40 mmol/l) will be checked	Out of range

[25] Display in measurement report under "**System - Setup - Edit Reports - Measurement Report**".

Aspiration status codes during measurement

List and interpretation of flags occurring in the AVL OMNI™ **during sample aspiration**. Described in service report under "**Options - Reports - Service Report - Aspiration & Conductivity**".

See also chapter 7, section "Measuring cycle - Sample distribution" und Seite 9-112.

Remark: *Aspiration Status Codes (ASC) for Solution 1, 3, 4 and 5 (solutions aspirated through the T&D module) can be found in Table 3 on page 9-104.*

List of flags that may occur during sample separation:

Aspiration status	Comb.	Flag (Code)	Logic	Text	Comment	Possible error cause
Sample in sample inlet path	--	14	SS2 time-out (on the way to SS2)	no sample in VSS	for all parameters in the requested module	sample container detection activated erroneously or SS2 defective
	--	40	no vacuum (during AQC aspiration)		for all parameters in the requested module	at AutoQC measure-ment no vacuum was build up
	--	41	SS5 time-out (during AQC aspiration)		for all parameters in the requested module	SS5 /AutoQC) could not detect sample during aspiration from the ampoule
BG separation	--	11	SS1 yes SS2 no (on the way to SS1)		this result is linked with the result from BG positioning	not enough sample to fill the module sufficiently or sample fragmented (but positioning will be attempted)
	--	13	SS1 time-out (on the way to SS1)	sample distr. error	for BG-, ISE- and MSS-module; attempt tHb measurement, if requested	clots or leaks
ISE separation (normally included in BG positioning)	--	08	SS1 no SS2 yes (at start of ISE positioning)		this result is linked with the result from ISE positioning	sample fragmented (but positioning will be attempted)
	--	07	SS1 no SS2 no (at start of ISE positioning)		this result is linked with the result from ISE positioning	no sample fluid left for ISE (but positioning will be attempted)
	--	11	SS1 yes SS2 no (at start of ISE positioning)		this result is linked with the result from ISE positioning	not enough sample to fill the module sufficiently or sample fragmented (but positioning will be attempted)

Aspiration status	Comb.	Flag (Code)	Logic	Text	Comment	Possible error cause
tHb or COOX separation	--	08	SS3 time-out SS2 no (on the way to SS3)	no sample detected		no sample fluid left (for tHb and COOX)
	--	11	SS3 yes SS2 no (on the way to SS3)	insufficient sample	sample is not aspirated into the module	not enough sample introduced or too much sample fluid lost
	--	13	SS3 time-out SS2 yes (on the way to SS3)	sample distr. error	sample could not be aspirated in the direction of the tHb- or COOX-module	clot, valve V2 does not switch or leak in tHb-sample path (cuvette)
tHb or COOX: Removing excess sample fluid	--	13	SS2 do not see end of sample when tHb positioning should start	sample distr. error	sample fluid could not be drained through the sample distributor	clot, valve V2 does not switch
MSS separation	--	20	SS4 time-out (on the way to SS4)	Distr. Error MSS	sample could not be aspirated to SS4 in the sample distributor	clots or leaks

List of flags that may occur during sample positioning:

Aspiration status	Comb.	Flag (Code)	Logic	Text	Comment	Possible error cause
BG positioning	--	1	conductivity signal not stable or too low	sample pos. error		clots, bubbles or sample not conductive, check V7
	5 + 11	12	SS1 has become empty + SS1 yes / SS2 no at separation	insufficient sample	is linked with the result from "BG separation"	insufficient sample or fragmented in the sample distributor
	--	2	conductivity breakdown not OK	sample sep. error	sample could not be distinguished from measuring chamber filling	VBI/VBO malfunction, clots at bypass nipple, sample aspiration does not start or starts too late, contamination in measuring chamber
	--	5	during positioning SS1 has become empty	end of sample det.	SS1 detects the end of the sample, but the measuring chamber is not completely filled	inhomogeneous sample is aspirated through measuring chamber or not enough sample.
	--	6	MCC / MCO not OK	irregular sample	Ratio between long and short contact path is not OK	inhomogeneous sample or measuring chamber not properly filled, e.g. air bubbles inside the BG electrodes
	--	3	conductivity value rise not OK	Ref. Sol. asp. error	error message only for pH and PCO_2	bubbles in sample or in KCL supply line, check MCI, R bottle ventilation problem, Ref. blocked (crystallization)
	--	4	conductivity level not stable	Ref. Sol. pos. error	error message only for pH and PCO_2	leaks or small bubbles, PO_2- or PCO_2 filling problem (BG), defective electrode sealing
ISE positioning	--	1	conductivity signal not stable or too low	sample pos. error		clots, bubbles or sample not conductive, check V11
	1 + 08	09	conductivity signal not OK + SS1 no SS2 yes at separation	no sample detected	is linked with the result "ISE separation"	fragmented sample was detected in sample distributor
	1 + 07	10	conductivity signal not OK + SS1 no SS2 no at separation	no sample detected	is linked with the result from "ISE separation"	no sample for ISE detected in sample distributor

	1 + 11	12	conductivity signal not OK + SS1 yes, 2 no at separation	insufficient sample	is linked with the result from "ISE separation"	sample too small or fragmented in sample distributor, contamination in measuring chamber
	--	2	conductivity breakdown not OK	sample sep. error	sample could not be distinguished from measuring chamber filling	sample aspiration does not start or starts late, contamination in measuring chamber
	--	6	MCC / MCO not OK	irregular sample	Ratio between long and short contact path is not OK	Inhomogeneous sample or measuring chamber not properly filled.
	--	3	conductivity rise not OK	Ref. Sol. asp. error	sample – Sol. R line could not be closed	bubbles in sample or in Ref. supply line, check MCI
	--	4	conductivity level not stable	Ref. Sol. pos. error		leaks or small bubbles, ISE wetting problem (Ca), dirty Cl-Electrode, defective electrode sealing
tHb or COOX positioning	--	21	first light level measured below limit	Cuvette Not OK	tHb/COOX - sample detection not possible	contamination in cuvette or light level (air) too low, aspiration too fast (old PP tubes)
	--	22	no change of light level	no sample detected	no signal change means beginning of sample is not detected	leak in sample path (e.g. cuvette, V4) or aspiration process much too slow (e.g. pump tubes)
	--	23	light level does not stabilize	sample pos. error	no stable signal means inhomogeneous filling	sample fragmented or not hemolyzed, aspiration process too slow (load limit)
MSS positioning	--	1	conductivity signal not OK	sample pos. error		clot, bubbles or sample not conductive
	--	2	conductivity breakdown not OK	sample sep. error	sample could not be distinguished from measuring chamber filling	sample was at VSI, sample aspiration does not start or starts late, contamination in measuring chamber
	1 + 11	15	SS4 no, before conductivity break down	insufficient sample	the separating air bubble for sample detection occurred only after SS4 detected air	insufficient sample or fragmented in sample distributor.

Table 3: Aspiration status codes during measurement

List of calibration flags List and interpretation of flags occurring in the AVL OMNI™ **during a calibration**. Described in service report under "**Options - Reports - Service Report - Repro & Quality**".

List of general flags that may occur during a calibration:

Status[26]	Flag	Meaning / Message on screen
OK	0	Calibration value OK with Sigma 1/2
OK	1	Calibration value OK
SP default	3	Default calibration value (e.g.: after electrode change): calibration pending □ calibrate for ready.
Repro nOK	4	Sigma not OK: 1. Decontaminate / call wetting routines. 2. Clean sample path. 3. Unacceptable sample type used ? Calibrate for ready. 4. Replace electrode / cassette.
Limits nOK	5	Sigma and mean not OK: 1. Check sample path for clots. 2. Repace electrode / cassette.
Calc. 1	6	Calculation error 1 (PC): 1. Check the baro value. 2. Re-barcode the reagents.
Calc. 2	7	Calculation error 2 (PC) □ rebarcode the electrode / cassette.
wait for CAL	8	Six pack not OK, "not OK INI": calibration was cancelled □ check reason and calibrate for ready.
NE Diff. nOK	9	*P*CO_2 NE calibration difference too great: 1. Unacceptable sample type used ? calibrate for ready. 2. Replace electrode.
TAU error	10	TAU not OK
Calc. 3	11	Precalculation not performed/not valid: 1. Sol. R leaking ? Clean bottle compartment, remove crystals. 2. Decontaminate MC cartridge. 3. Call wetting routines. 4. Replace electrode / cassette.
no sample	12	Not calibrated because of general aspiration problems: 1. Check fluidics. 2. Check fillport / T&D disk. 3. Try locating error with “FMS volume error” troubleshooting. 4. Reseat electrodes / tHb cuvette. 5. Replace PP tubing.
no ref. sol.	13	Not calibrated because of reference solution aspiration problems: 1. Prime the reference system using “Fill Ref Electrode”. 2. Check seating of Sol. R bottle (air vent punctured properly ?) 3. Call wetting routines.
Ref. nOK	14	Reference point (MSS) not OK: Reference point Cal (Sol. D) nOK □ calibrate for ready.
1P error	15	First calibration point not OK: 1pt Cal nOk □ calibrate for ready.
Air bubble	16	Air bubble over electrode O_2 zero calibration: 1. Decontaminate / Call wetting routines. 2. Replace Sol. 4.

see next page

[26] Display in electrode status report under "**Options - Reports - Elektrode Status**".

FMS error	17	Mixing ratio out of permissible range (%a): 1. Reseat bottles Sol. B & C and check aspiration. 2. Check if the air vents are punctured properly.
Cancel	20	Calibration canceled (UC internal): calibration was cancelled □ calibrate for ready.
TEMP error	21	Temperature alarm: 1. Check ambient temperature. 2. Replace fan filter (on back panel). 3. Swich analyzer Off/On.
LF error	22	Conductivity calibration not performed (Filling stop /mean and/or Sigma not within limit): print out electrode status report & check error text for LFB & LFC lines.
wait for CAL	24	Electrode / module deactivated: parameter was deactivated □ calibrate for ready.
ADC Error	26	ADC hardware problems
FMS vol. nOK	27	Time-out in FMS vol. measurement: 1. Try locating error with “FMS volume error” troubleshooting. 2. Replace PP tubing.
Mean nOK	28	Six pack mean not OK: 1. Sol. R leaking? Clean bottle compartment, remove crystals. 2. Replace electrode / cassette.
ADC Overflow	29	Readings exceed ADC upper limit: 1. Prime the reference system using “Fill Ref. Electrode”. 2. Reseat electrode. 3. Replace electrode / cassette.
ADC Underflow	30	Readings exceed ADC lower limit: 1. Prime the reference system using “Fill Ref. Electrode”. 2. Reseat electrode. 3. Replace electrode / cassette.
No cond. sol.	31	No Na-conditioning solution = Na alarm: 1. Replace Sol. 2. 2. Check Sol. 2 aspiration. 3. Check fillport & T&D disk for contamination.
No zero sol.	32	No O_2 zero solution = O_2 Alarm: 1. Replace Sol. 4. 2. Check Sol. 4 aspiration. 3. Check fillport & T&D disk for contamination.
0P error	33	O_2 zero point not OK: check Sol. 4 aspiration & calibrate for ready.
Sol. exhausted	34	pH value six pack for O_2 zero solution not OK □ replace Sol. 4.
Lin. nOK	35	Ratio Cal1/Cal2 not OK: 1. Replace MSS cassette. 2. Replace MSS reagents Sol. 1, 3, 5 & D.
Inter. nOK	36	Ratio BSA/Glu BSA/Lac during Cal3 not OK □ replace MSS cassette.
No sample (pol)	37	Polarization was not performed, because sample volume was too small: sample used for polarization was fragmented or too small. □ repeat MSS polarization.
Polarizing	38	After polarization MSS signals not yet in permissible range: “Sensor is polarizing now. Please wait.”
Pol. cancelled	39	Polarization was terminated manually: check aspiration of Sol. 3 , D & R3 and repeat MSS polarization.

see next page

d not OK	40	Thickness of layer out of range: 1. Check for obstructions in tHb path. 2. Call wetting routines. 3. Replace tHb cuvette. 4. And perform tHb calibration !
tHb (ref) / COOX (ref) nOK	41	Reference below the limit: 1. Check for obstructions in tHb path. 2. Replace tHb cuvette. 3. And perform tHb calibration !
Cuv. changed	42	Cuvette changed and interrupt: calibration is pending □ perform tHb calibration.
rejected	43	Rejected: last cal was rejected □ perform tHb calibration.
Calc. 4	44	Calculation error tHb / COOX (PC) □ replace cuvette.
SW error	50	Calibration of the wavelength running
HW error	51	Cannot calibrate because of hardware problems
Lamp error 1	52	Error during neon light determination
Lamp error 2	53	Halogen lamp error ti (average time) > 120 ms □ replace cuvette.
Calc. 5	54	Calculation error 5
Optics error 1	58	During check before measurement, the maximum intensity of the neon lamp is outside the limit. Wave lenght calibration alarm.
Comm. error	59	Slave error (CCD processor) during calibration
Calk. 6	60	Calculation error 6
Optics error 2	65	No neon lamp peak detected
A/B not OK	69	A/B calculation for urea is not OK: 1. Replace MSS cassette. 2. Replace MSS Sol. 1, 3, 5, & D.
IfS Repro nOK	70	Interference sensor sigma not OK (Flag 4): 1. Call wetting routines. 2. Unacceptable sample type used ? Calibrate for ready. 3. Replace MSS cassette.
IfS Limits nOK	71	Interference sensor sigma and mean value not OK (Flag 5) □ replace MSS cassette.
IfS Calc 1	72	Interference sensor calculation error 1 (UC) (Flag 6) □ re-barcode the MSS reagents.
IfS Calc 2	73	Interference sensor calculation error 2 (UC) (Flag 7) □ re-barcode the MSS cassette.
IfS SP-invalid	74	Interference sensor six pack not OK (Flag 8): calibration was cancelled □ check reason and calibrate for ready.
IfS Calc 3	75	Interference sensor precalculation not performed/not valid (Flag 11): 1. Call wetting routines. 2. Replace MSS cassette.
IfS Ref. nOK	76	Interference sensor reference point not OK (Flag 14): reference point Cal (Sol.D) nOK □ calibrate for ready.
IfS ADC error	77	Interference sensor ADC hardware problems (Flag 26)
IfS Mean nOK	78	Interference sensor six pack mean value not OK □ replace MSS cassette.
IfS ADC Overf.	79	Interference sensor readings exceed ADC upper limit □ replace MSS cassette.
IfS ADC Underf.	80	Interference sensor readings exceed ADC lower limit □ replace MSS cassette.

Table 4: List of calibration flags

Aspiration status code during calibration

List and interpretation of flags occurring in the AVL OMNI™ during aspiration of calibration solution. Described in service report under "**Options - Reports - Service Report - Aspiration & Conductivity**".

List of general flags that may occur during aspiration of calibration solution:

Aspiration status	Comb.	Flag (Code)	Logic	Text	Comment	Possible error cause
BG/ISE: Mixing MSS: D positioning	--	0		OK		
	--	1	conductivity signal not OK (not reproducible or too low)	no sample	aspiration of solution not bubble-free; possibly wrong positioning of mixture in FMS	SD cartridge defective; FMS bubble trap leaking; FMS leaking; V4 vent is blocked
	--	2	conductivity value rises after measuring chamber input valve closes	no sample	“last moment“-bubble; leak in measuring chamber	improper wetting of SD - T-piece; defective electrode (ISE)
	--	3	conductivity value rise not OK	no ref. sol.	Ref. Sol. does not flow (bubble-free) or column interrupted (at Junction electrode)	Ref. Sol.-tube kinked/ blocked; R-bottle not ventilated
	--	4	conductivity value unstable	no ref. sol.	column interrupted because Ref. valve closed	improper wetting of Junction electrode; Ref. electrode/ Junction electrode defektive
	--	5	condcutivity value rises before measuring chamber input valve closes	no sample	similar to Flag 2	
	--	6	conductivity value drops before measuring chamber input valve closes	no sample	similar to Flag 2	

Table 6: Aspiration status code at calibration

Interpretation of FMS times (tn)

Printouts of FMS times on the service report are to be interpreted as follows (see also "FMS volume error", page 9-7):

Measured (calculated)	Displayed	Status	Commend
< -0.30	< -0.30	not OK	Solution in BG too early (cannot be reversed)
-0.30 to 0	0	OK	Lower limit value (falling below is tolerated)
0 to 1.50	0 to 1.50	OK	Normal range
1.50 to 1.70	1.50	OK	Upper limit value
> 1.70	> 1.70	not OK	Solution in BG too late

Table 7: FMS times

All times that result in a not OK, are set to 0.60 (alarm ⇒ default) after display.

Calibration parameter limits

Parameter	U Mean min. [mV]	U Mean typ. [mV]	U Mean max. [mV]		D Mean min. [mm]	D Mean typ. [mm]	D Mean max. [mm]
tHb (air)	690	1500	2200		0,06	0,1	0,13
Sample	0	50 – 400	2400				

Parameter	LFB Mean min. [mV]	LFB Mean typ. [mV]	LFB Mean max. [mV]	LFB Sigma max. [mV]	LFC Mean min. [mV]	LFC Mean typ. [mV]	LFC Mean max. [mV]	LFC Sigma max. [mV]
BG	1850	2100	2400	2	80	105	150	2
ISE	1300	1450	1750	4	20	70	100	4

Table 8: Conductivity

Parameter	1P Cal. Mean min. [mV]	1P Cal. Mean typ. [mV]	1P Cal. Mean max. [mV]	1P Cal. Sigma max. [mV]	Slope (2P Cal.) Mean min. [mV]	Slope (2P Cal.) Mean typ. [mV]	Slope (2P Cal.) Mean max. [mV]	Slope (2P Cal.) Sigma max. [mV]
pH	-2100	500	1600	6	-340	-305	-250	6
*P*CO2	-1300	-1000	2000	6	-160	-143	-110	6
*P*O2	250	330	550	9	-10	2	15	6
Na	-1700	950	2300	4	110	130	140	6
K	-1700	550	2100	4	110	130	140	6
Cl	-2300	700	1700	4	-120	-108	-90	6
Ca	-2000	500	2200	4	-95	-87	-65	6

Table 9: Electrode potentials (BG/ISE/tHb)

Parameter	Reference				1P Cal.			
	Mean			Sigma_rel.	Mean			Sigma_rel.
	min [mV]	typ [mV]	max [mV]	max [mV]	min [mV]	typ [mV]	max [mV]	max [mV]
BSA	3	30	760	= (Int+Ref x 0.35) x 50%	-40	5	40	= Int x 14.3%
Lac	3	50	950	= (Int+Ref x 1) x 8%	55	270	650	= Slp x 1.1%
Glu	3	40	760	= (Int+Ref x 1) x 8%	45	210	500	= Slp x 1.4%
Urea	-1880	100	1880	= Slp x 3%	115	160	190	= Slp x 2%
K	-1410	300	2021	= Slp x 8%	-2500	-	2500	= Slp x 100%
NH4	-1880	300	2115	= Int x 8%	-2500	-	2500	= Int x 100%
LF	500	900	1500	100				

Parameter	Slope				Interference			
	Mean			Sigma_rel.	Mean			Sigma
	min [mV]	typ [mV]	max [mV]	max [mV]	min [mV]	typ [mV]	max [mV]	max [mV]
BSA	-40	5	40	= Int x 14.3%	19	70	300	= Int x 14.3%
Lac	265	1100	2280	= Slp x 4.4%	19	90	300	= Slp x 1.1%
Glu	225	900	1740	= Slp x 5.7%	23	80	230	= Slp x 1.4%
Urea	159	240	330	= Slp x 2%	50	80	130	= Slp x 4%
K	42	55	70	= Slp x 15%	-2500	-	2500	= Slp x 100%
NH4	18	55	80	= Int x 10%	37	60	110	= Int x 15%

Parameter	Linearity (Slope/1P Cal.) Mean		
	min. [mV]	typ. [mV]	max. [mV]
BSA	-	-	-
Lac	3.5	4	5.5
Glu	3.5	4	5.5
Urea	1.38	1.5	1.74
K	-	-	-
NH4	-	-	-

Parameter	Default for Sigma_rel. calculation Mean		
	Slope [mV]	Int [mV]	
BSA	-	70	
Lac	900	-	
Glu	700	-	
Urea	225	-	
K	50	-	
NH4	-	70	

Parameter	Linearity (1P/Int. Cal.) Mean		
	min. [mV]	typ. [mV]	max. [mV]
Urea	1.4	2	2.4
K	-	-	-
NH4	-	-	-

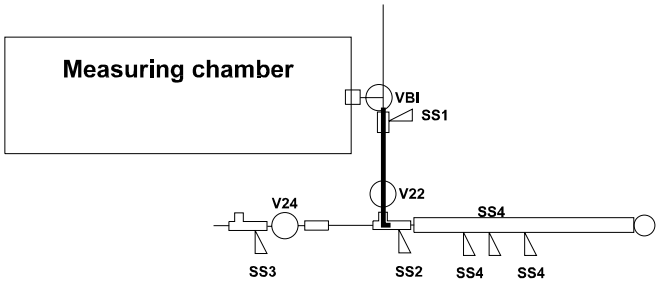
Parameter	Paramter A and B		
	min.	typ.	max.
Urea	0	30	10000

Parameter	Interference Sol. 1		
	min.	typ.	max.
Lac / BSA	0.25	1	2
Glu / BSA	0.25	1	2

Table 10: Electrode potentials (MSS)

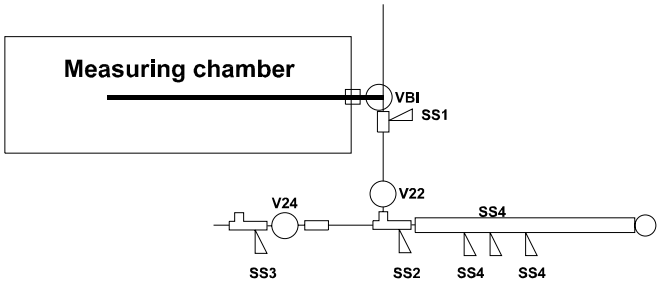
Examples for combined Aspiration status codes

- **"sample volume too small" (for BG)**



SS1 detects sample
SS2 detects no sample

+

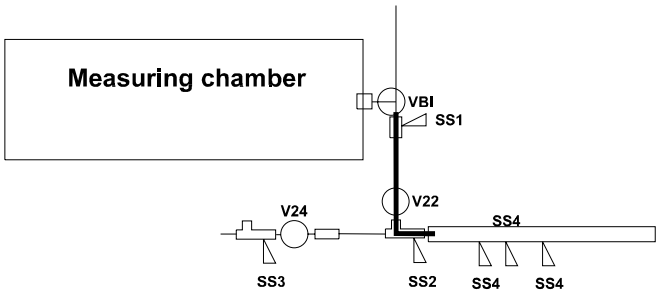


BG measuring chamber not enough filled

⇓

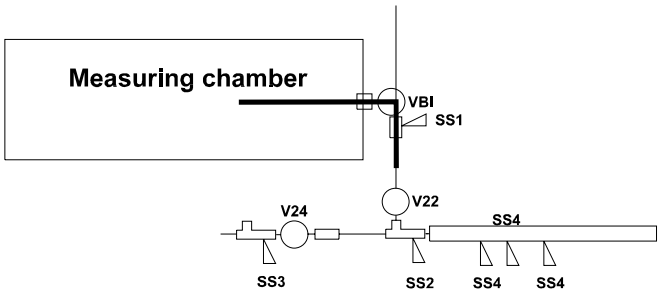
"Sample volume too small"

- **"sample pos. error"**



SS1 detects sample
SS2 detects sample

+

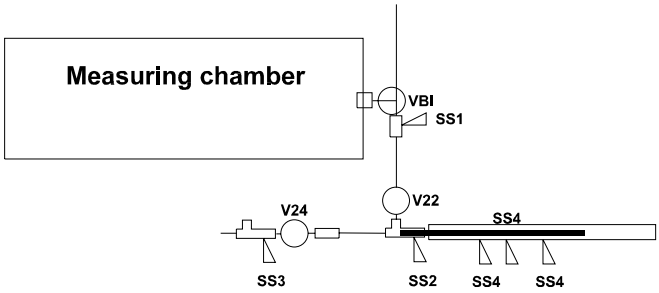


BG measuring chamber not enough filled because of aspiration problem

⇓

"sample pos. error"

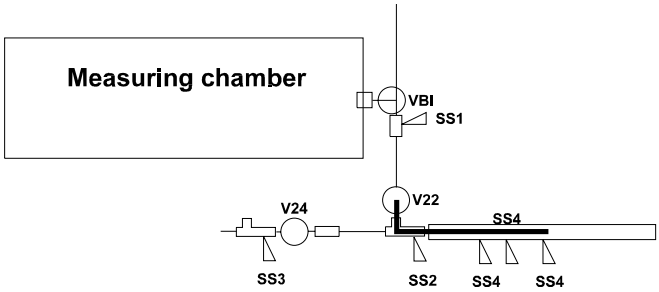
- **"sample distr. error"**



BG/ISE

SS2 detects sample

+



SS1 detects no sample
SS2 detects sample

⇓

"sample distr. error"

or

tHb/COOX

SS2 detects sample

+

SS3 detects no sample
SS2 detects sample

⇓

"sample distr. error"

10 PREVIOUS REVISION LEVELS

Manual revision 2.0, December 1995 10-2

Manual revision 3.0, March 1996 10-3

Manual revision 4.0, July 1996 10-25

Manual revision 5.0, January 1997 10-29

Manual revision 6.0, August 1997 10-33

Manual revision 7.0, May 1998 10-45

Manual revision 8.0, November 1998 10-49

Manual revision 9.0, May 2000 10-79

10 Previous revision levels

NOTE: *This chapter contains only documentation of previous revision levels!*

Manual revision 2.0, December 1995

modified chapters: whole manual

applicable from serial no. on: 1146

Summary

Chapter - Page[1]	**Modification/Addition**
Cover page	Increase of revision number from 1.0 to 2.0
Contents	updated
Update of the whole manual	COOX module added
5-74	Because of changing the Id. no of BP1800 to BP2063 (typ A) or BP2064 (typ B), list of valves actualized.

[1] Number of pages revers to Service Manual Rev. 1.0, June 95

Manual revision 3.0, March 1996

Chapter 2 (revisions)..... 10-5

Chapter 5 (Function modules from A - Z)..... 10-6

modified chapters: 2, 3, 4, 5, 6, 8, 9, 10 and 11

applicable from serial no. on: 1500

Summary

Chapter - Page[1]	**Modification/Addition**
Cover page	Increase of revision number from 2.0 to 3.0
Contents	updated
2-1	List of electronic updated
2-2	Revision number updated
3-2	Figure updated
3-6	Hct resolution corrected
3-10	"* typical for Hct = 40 %" at "Sample Volumes" added
3-11	Id. no of Solution 4 changed from BP1896 to BP2068
3-13	• Data management: 120 MB hard disk added • hard disk added • width of paper changed from 112 mm to 120 mm • paper length changed from approx. 25 m / roll to approx. 50 m / roll • permissible tolerance at voltage range changed from ± 10 % to +6%/-10%
3-14	CE-conformity added
4-2	Figure updated
4-3	• Figure 4-2 actualized • Figure "Interface Board (PC-version PC104)" added
5-3	Barcode wand added
5-12	Figure 5-3 deleted
5-19	Figure 5-7 updated
5-22	Figure 5-9 updated
5-23	• Text modification at "Changing the ISE-measuring chamber" • Addition of: "Changing the Connector board" "Changing the MC cover complete" "Changing the MC prism" "Changing the MC electrode holder" "Changing the Center seal for MC" "Changing the MC foil" and "Changing the MC illumination foil"
5-25	• Electrode plugs have been changed - Figure 5-11: MC-cartridge updated • Item 4 of "Changing the Measuring chamber-cartridge" changed, because pressing the electrode plugs together is no longer necessary

[1] Number of pages revers to Service Manual Rev. 2.0, December 95

5-26	First NOTE changed
5-40	Desired position of rocker switches on PolyOx-KX-control 9700 LY3 added
5-47	Item 7 of "Changing the power supply unit" changed
5-48	To comply with EMC guidelines, especially with Standard for permissible interference, it was necessary to perform the following modifications: • Protection of TFT flat screen and electronics • Protection of screen cable and implementation of symmetric data transfer to screen • Implementation of various BF shields and large-surface grounding in the housing • From SN 1500 on, PC models B486SLC (AT96) and MSM4S6 (PCI04) will be used simultaneously and a new screen model will be used • FLATIF is no longer applicable
5-88, 5-90, 5-94, 5-96	Figures updated and added
6-1, 6-5	• Addition at Figure 6-1 at "Cal." • In figure 6-4 at "Util - Analyzer actions - Fluid actions“, "Deproteinizing MC-Cartridge", as well as at „Util - Service area - COOX-Module". "Offset" added
8-2	"Deproteinizing MC-Cartridge" added
8-6	• Text modification at "Optics test" • "Offset" added
9-48	Appendix deleted
10	New chapter "Previous revision levels"!
11	Figures updated

Chapter 2 (Revisions)

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_3A	**Mainboard**	9700AC1	I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_69	**MC-heat control**	9700LB4	na
BB0521	Rev_37	**Amplifier POT 9799LP1**	9700LP1	na
BB0532	Rev_11	**MC-ceramic heater**	9700LB9	na
BB0533	Rev_33 Rev_44	**Heat foil**	9700LB3	na
BB0534	Rev_45	**MC-cover heat control**	9700LB8	na
BB0535	Rev_58	**Amplifier REF 9700LP3**	9700LP3	na
BB0536	Rev_45	**Amplifier AMP 9700LP2**	9700LP2	na
BB0539	Rev_59	**Fluid level detector**	9700LC4	na
BB0542	Rev_8B Rev_9C	**Interface board**	9700CB1	na
BB0548	Rev_58	**T&D-control**	9700LT1	I18: XP0079 CS: $0F61
BB0551	Rev_22	**tHb-board**	9700LB5	na
BB0555	Rev_66	**Motherboard**	9700LC6	na
BB0582	Rev_45	**SD-heat control**	9700LC7	na
BB0584	Rev_02	**BFR-board**	9700LN3	na
BB0630	Rev_03	**Hemolyzer board**	9700LO2	na
BB0648	Rev_11	**Relay board**	9700LCC	I1: XZ0111 CS: $43FE I2: XZ0110 CS: $43DA
BB0651	Rev_11	**T&D-sensor**	9700LT3	na
BB0570	Rev_22	**Touch panel control**	9700LR1	I11: XP0088 CS: $13A8
BB0668	Rev_02	**LCD-converter**	9700LR3	na
BB0657	Rev_02	**Sensorprint Waste**	9700LCD	na
BB0663	Rev_11	**POLYOX-KX-Control**	9700LY3	I21 XP0139 I22 XZ0109 (3.01)
BB0662	Rev_00	**POLYOX-Digital**	9700LY2	I5 XP0138
BB0661	Rev_01	**POLYOX-Analog**	9700LY1	na
BB0725	Rev_00	**POLYOX-Heat**	9700LY4	na
EN0290	Rev_2.2	**PC**		
EN0289	Rev_82	**FLATIF**		
EN0288	Rev_61	**AVLIFB**		
EL0230		**TFT-converter**		

Chapter 5 (Function modules from A - Z)

Changing the power supply unit

When changing the power supply unit, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Open the 6 cross-slotted screws on the back of the analyzer.
3. Remove the rear wall diagonally in the upward direction.
4. Remove the grounding plug from the rear wall.
5. Unplug all cables and grounding from the power supply unit.
6. Loosen the cross-slotted screw (see Fig. 5, **9**) and remove the power supply unit towards the rear of the analyzer.

Installation is done in the opposite sequence.

PC-components

PC-tower

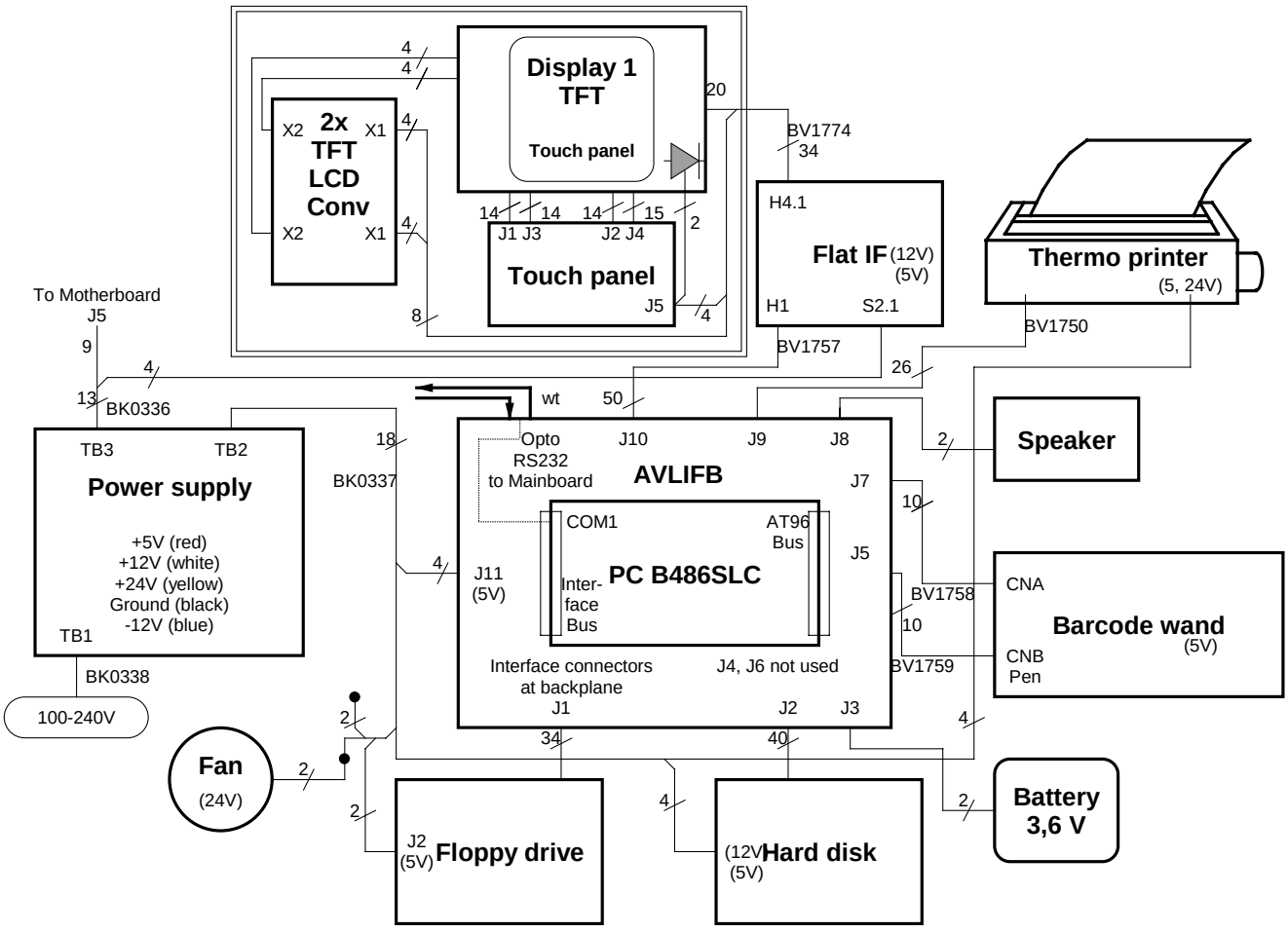


Fig. 1: PC-tower - Display

The PC-tower in the AVL OMNI™ includes the following components:

PC-board based on the 486 SLC
Interface board (AVLIFB)
Floppy drive
Hard disk
Barcode scanner - unit
Thermo printer
Speaker
Accu 3,6 V
Power supply unit for the entire AVL OMNI™
Fan (for the PC-unit)

The display of the AVL OMNI™ is a so-called active TFT-LCD, with the special advantage having a very large reading angle range of more than +/- 45 ° vertically.
A flat cable from the AVLIFB (from J10) runs to this FLATIF-board (plug connector H1). The FLATIF is screwed on the foot of the screen, which then again is fastened to the upper part of the Measuring chamber plate.

A cable tree to the screen runs from FLALTIF plug connector H4.1 and is then divided, leading to the actual flat screen, the Touch panel control (for the Touch screen-"keyboard") as well as to both TFT LCD-converters (necessary for the back-ground lighting).
The Touch panel control contains its own microcontroller which transforms the signals from the matrix of the touch panel in a serial signal. It is located in the screen housing.
The two TFT LCD converters are transformers and provide the voltage supply for both flourescent lamps, located behind the flat screen in the screen housing.

The hard disk is fastened to the innerside of the PC-tower, the floppy drive on the rear side of the PC-towers (seen from the rear wall of the analyzer) (see Fig. 6, **2** and **3**).

Changing the entire PC-tower

When changing the entire PC-tower, please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-1 (with the exception of 6.), under "General information on assembly and disassembly of components".
3. Unscrew the right side part (the screws are accessible from the inside).
4. Gain access to the rear of the analyzer.
5. Unplug all cables of the PC-tower.
6. Loosen the two cross-slotted screws on the side wall and at the bottom of the analyzer and remove the PC-tower towards the rear of the analyzer.

Installation is done in the opposite sequence.

PC "B486SLC"

The basic part of the PC is a PC-board of type B486SLC.
The single printed circuit board PC B486SLC contain complete PC electronics, including storage and driver for the floppy drive, hard disk, printer and the two types of flat screen. It is connected on the AVLIFB with 2 plug ledges (AT96 bus and interfacebus). This is fastened to the rear wall of the PC-tower (see Fig. 6, **5**) and includes the necessary interface-expansion with the corresponding plug connectors which are located on the rear wall of the analyzer.
The Barcode control (see Fig. 6, **8**) serves as an Interface between the Barcode scanner (connected on the rear wall with its own plug connector) and the PC and is mounted on the left outside wall of the PC-tower (as seen from the rear wall).
The printer module has a paralell Centronix-interface and is connected to the respective PC-interface. It is mounted on the PC-tower.

The PC-board B486SLC consists of:

- two serial interfaces (TTL gauge) COM1 (interface for Main control) and COM2 (interface for Touch screen),
- a paralell interface designed as PS/2 compatible LPT1 (internal printer),
- a VGA-compatible Local bus video-interface for:
  – analog Monitors
  – active Color-LCD
  – passive Color-LCD
- 512 kB Video RAM,
- a keyboard interface for standard PC/AT-keyboards,
- a floppy drive-interface for two 3,5" floppy drives,
- a hard disk-interface for two IDE hard disk drives,
- a real time clock with externally buffered (128 Byte),
- 4 MB working storage with parity,
- a CPU 486SLC with 33 MHz systemclock,
- a PC/AT-Motherboard-logic (two DMA-controllers, two interrupt-controllers, one Timer and one DRAM-controller),
- a BIOS,
- a Watch-dog and Reset-generator.

The periphery signals for delivery on the AVLIFB, are conducted on a 128-poled, the BUS-signals of the AT 96-BUS on a 96-poled VG-ledge.

Changin the PC-board B486SLC

When changing the PC-board (see Fig. 6, **4**) please proceed in the following manner:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-1 (with the exception of 6.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the 26-poled flat cable (dataline) from the Thermo printer.
5. Unscrew and the four cross-slotted screws, which hold the Thermo printer and remove.
6. Disconnect all cables from the AVLIFB (see Fig. 6, **5**).
7. Uscrew the 4 cross-slotted screws, which hold the Interface board and remove.
8. Pull off the PC-board from the Interface board.

Installation is done in the opposite sequence.

NOTE: *Has your AVL OMNI™ for the components PC-board B486SLC, AVLIFB and FLATIF one of the following revision levels, replace in case of failure always all three boards.*

PC-board B486SLC:	*12*
AVLIFB:	*51*
FLATIF:	*7.3*

At higher revision levels the components can be replaced seperately.

Interface board "AVLIFB"

Photoconductor interface on COM1

The transmit- and receive signals of the serial interface COM1 of the PC-board are designed as optical interface.
Only transmit- and receive-signals from the TTL-level on light or from light on the TTL-level are converted.
These TTL-signals are shown over LED's for control purposes.

Touch-panel interface on COM2

The signals of the touch panels are carried on the receive input of the serial interface COM2.

Serial interfaces COM3, COM4, COM5, COM6

Two IBM-compatible multifuctional building elements, each with two serial interfaces and one printer interface are integrated on the AVLIFB. On the one hand, the signals of the AT-96-BUS are transferred to these building elements, on the other, the signals of the serial interfaces are conducted over the RS232/V24 level converter on 9-poled SUB MIN D-bush. The signals of the printer interface are carried out. This printer board can be reached as a LPT2. (see Fig. 5-19)

Keyboard and Barcode scanner interface

The Barcode scanner used, allows the mixed operation of the scanner unit together with a standard PC/AT-keyboard. To assure this operation, the signals from the keyboard are carried out by an external connection "**Keyboard**" on the connector J7.
The signals of the scanner unit are carried out over the external connection "**Barcode**" on the connector J5 (see Fig. 2 and Fig. 3).

Printer interface LPT1 und LPT2

The in the AVL OMNI™ integrated printer is connected to the computer over the connector J9 on the logical interface LPT1. The signals of the second Thermo printer board are ranked as LPT2 on the external connection "**LPT2**". (see Fig. 2 and Fig. 3).

Flatdisplay interface

The signals of the active color LCD´s are carried by the 128-poled VG-ledge A2 on a 50-poled connector J10 (see Fig. 2).

Analoge VGA interface

The transfer of the color signals to an external screen takes place over this interface. When an external screen is connected, the touch screen of the AVL OMNI™ is inactive, if the external screen was connected before turning on the AVL OMNI™.

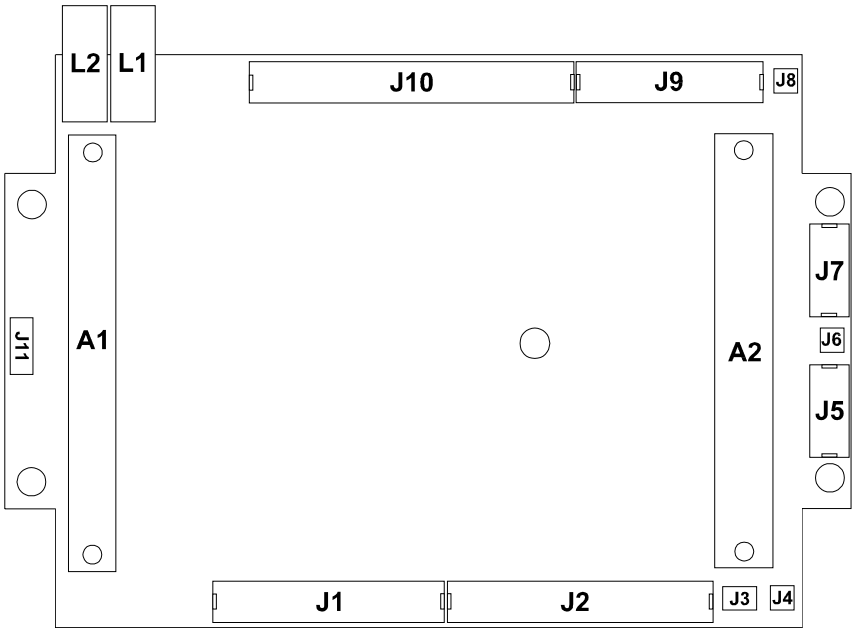


Fig. 2: AVLIFB (1)

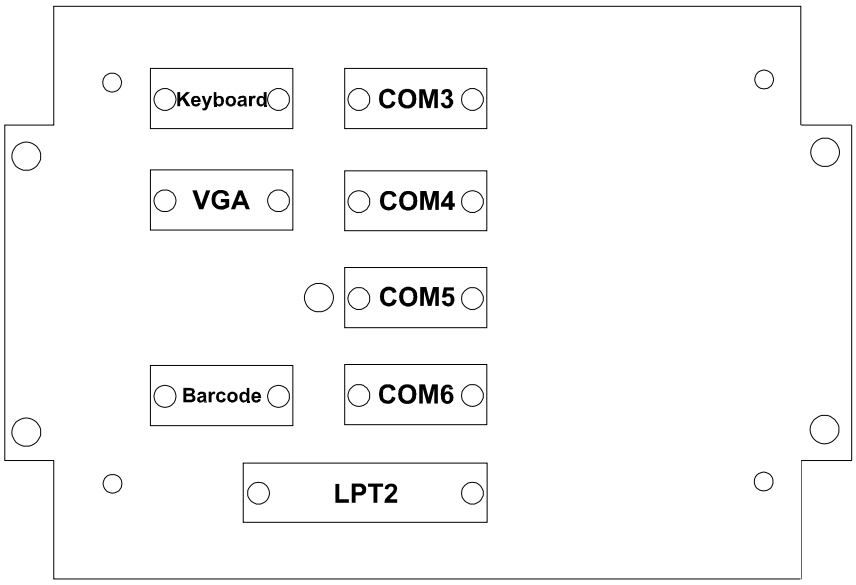


Fig. 3: AVLIFB (2)

Changing the Interface board "AVLIFB"

The changing of the Interface board (see Fig. 6, **5**) is done in the same manner as the changing of the PC-board, see page 10.

NOTE: *Has your AVL OMNI™ for the components PC-board B486SLC, AVLIFB and FLATIF one of the following revision levels, replace in case of failure always all three boards.*

PC-board B486SLC:	*12*
AVLIFB:	*51*
FLATIF:	*7.3*

At higher revision levels the components can be replaced seperately.

Flatdisplay interface board "FLATIF"

The signals to the control of both displays run from AVLIFB (J10, see Fig. 2) over a flat belt cable to FLATIF, which is mounted on the foot of the display. The line which is provided by the cable, is connected to the board, with an adapted, passive resistor array.
The active color-LCD is connected to the 34-poled connector H4.1.
The required voltages (5 V, 12 V) are supplied by the plug connector S2.1 (see Fig. 4).

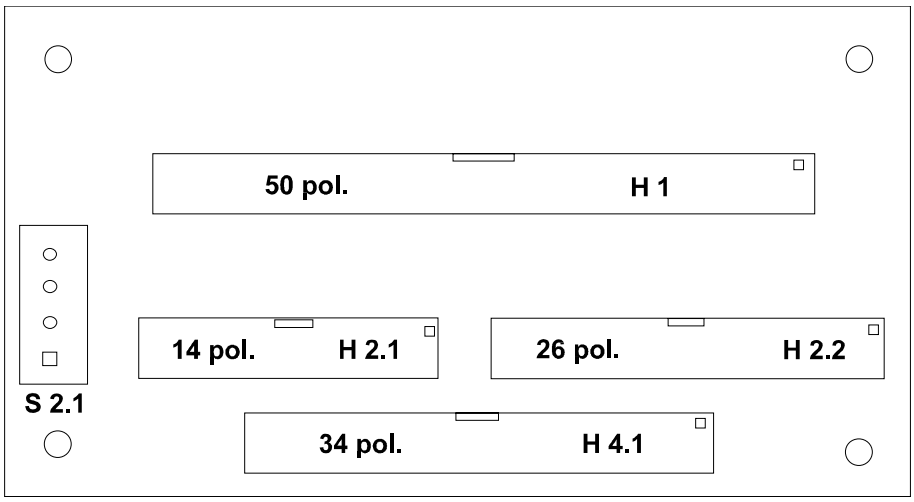


Fig. 4: FLATIF

Changing the FLATIF

When changing the FLATIF (see Fig. 8, **2**) the fan unit is to be dismounted. Please follow the directions for "Changing the Fan and the Filter" (see chapter 5).

After dismounting the fan unit, please proceed in the following manner:

1. Remove all cables from the FLATIF an loosen the four holding screws.
2. Remove the FLATIF.

Installation is done in the opposite sequence.

NOTE: *Has your AVL OMNI™ for the components PC-board B486SLC, AVLIFB and FLATIF one of the following revision levels, replace in case of failure always all three boards.*

PC-board B486SLC:	*12*
AVLIFB:	*51*
FLATIF:	*7.3*

At higher revision levels the components can be replaced seperately.

Changing the Flourescent lamps

When changing the flourescent lamps, please proceed in the following manner:

1. Switch off the AVL OMNI™.
2. Open the 4 cross-slotted screws on the Touch screen and remove the rear wall of the Touch screen.
3. Loosen the screws on the Touch panel control and disconnect these cables.
4. Remove all other cables of both supply-platines.
5. Remove the 4 distance bolts and open up the screen plate.
6. Remove both sheet metal strips which cover the flourescent lamps.
7. Remove all cables of the flourescent lamps out of their guidings and pull off.
8. Remove the flourescent lamps.

Installation is done in the opposite sequence.

Changing the entire Touch screen

When changing the entire Touch screen, the fan unit is to be dismounted. Please follow the directions for "Changing the Fan and the Filter" (see chapter 5).

After dismounting the fan unit, please proceed in the following manner:

1. Remove all cables from the FLATIF.
2. Remove both tubes (see Fig. 7, **2**) on the Sample distributor and remove from the securing clips.
3. The Touch Screen can now be dismounted by removing the five cross-slotted screws.

Installation is done in the opposite sequence.

NOTE: *Do not exchange the two tubes on the Sample distributor when reconnecting.*

LCD-Display 1

Panel size	10,4“
Pixel format	640 x 480
Dot pitch	0,11 x 0,33 mm
Outline dim.	283 x 217 x 25 mm
Active area	211,2 x 158,4 mm
Backlight type	Hot cathodic flourescent tubes (HCFT, dual)
Colors	512
Temperature range	0 to 60 °C
Contrast	60:1
Viewing angle	horizontal: ± 45° vertical: 10°, 30°
Response time	80 ms
Viewing angle optimum	6 o’clock

Hard disk

Changing the Hard disk

When changing the Hard disk (see Fig. 6, **3**) please proceed in the following manner:

1. Follow the steps 1. to 10. on page 5-1 (with the exception of 6.), under "General information on assembly and disassembly of components".
2. Gain access to the rear of the analyzer.
3. Disconnect the power supply and the 26-poled flat cable (dataline) from the Thermo printer.
4. Unscrew and the 4 cross-slotted screws, which hold the Thermo printer and remove.
5. Disconnect the power supply and the data lines from the hard disk.
6. Uscrew the 4 cross-slotted screws, on the side walls of the PC-tower.

NOTE: *When re-installing the Hard disk, please take care that the supply line of the flat cable (red) is positioned next to the power supply. Further, pay attention that the supply line from the Thermo printer is not exchanged with that of the Hard disk (plug labelling).*

After changing the hard disk, the barometric sensor and the polarisation voltage is to be newly set (see Chapter 8, "Service area - Setup - BP Set resp. O2-UPOL").

Installation is done in the opposite sequence.

Changing the Battery, Loud-speaker and Fan

When changing the battery, horn and fan (see Fig. 6, **6, 7, 9**) please proceed in the following manner:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page on page 5-1 (with the exception of 6.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the 26-poled flat cable (dataline) from the Thermo printer.
5. Unscrew and the 4 cross-slotted screws which hold the Thermo printer and remove.
6. **Loudspeaker**: Press the white platine fixing lever together and pull off the support.
   Battery: Press the battery holder downward.
   Fan: Disconnect the supply line and remove the four holding screws.

Installation is done in the opposite sequence.

Changing the Floppy drive

When changing the Floppy drive (see Fig. 6, **2**) please proceed in the following manner:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page on page 5-1 (with the exception of 6.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect the power supply and the dataline from the floppy drive and remove the holding screw (see Fig. 6).
5. Push the floppy drive towards the side wall of the analyzer from the PC-tower.

Installation is done in the opposite sequence.

NOTE: *To guarantee a troublefree operation of the floppy drive make sure that the side part does not collide with the floppy drive. Adjust the side part if necessary.*

Figures

PC-tower - rear view

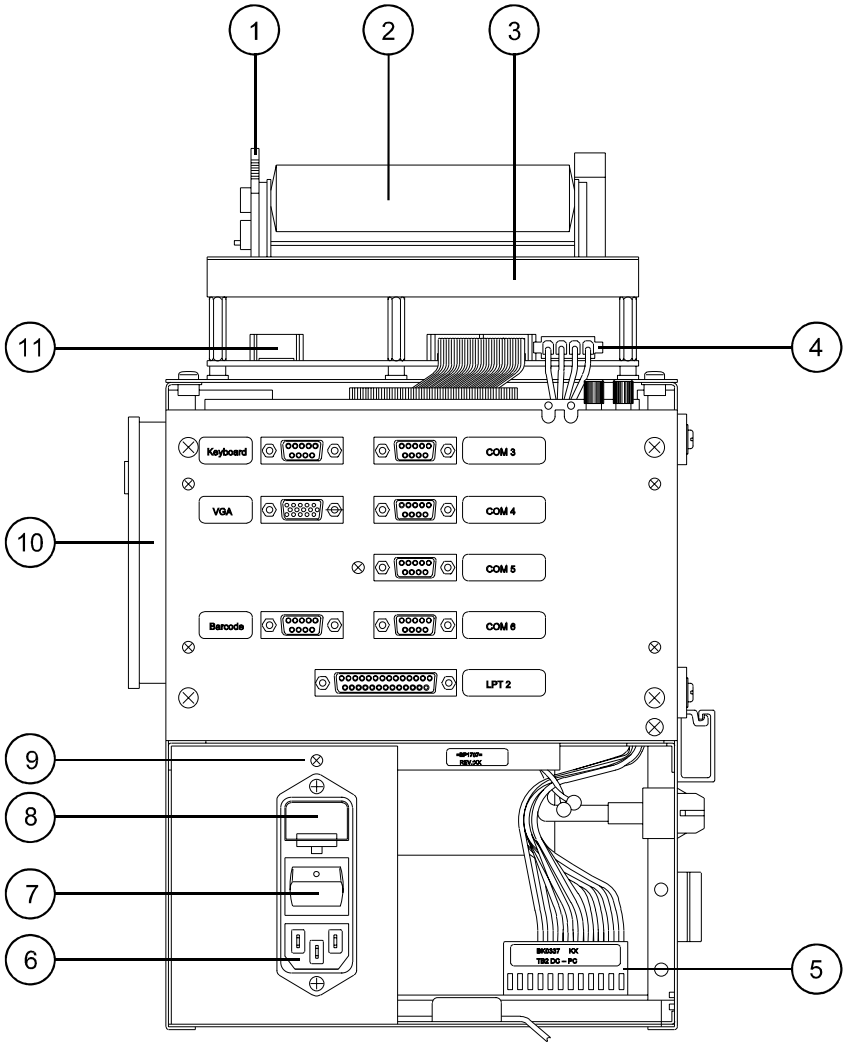


Fig. 5: PC-tower - rear view

① ..... Printer lever
② ..... Paper roll axis
③ ..... Thermo printer
④ ..... Power supply - Thermo printer
⑤ ..... Power supply - AVL OMNI™
⑥ ..... Power supply
⑦ ..... Master switch
⑧ ..... Fuses
⑨ ..... Clamping bolt for power supply
⑩ ..... Floppy drive
⑪ ..... Printer-dataline

PC-tower - topview

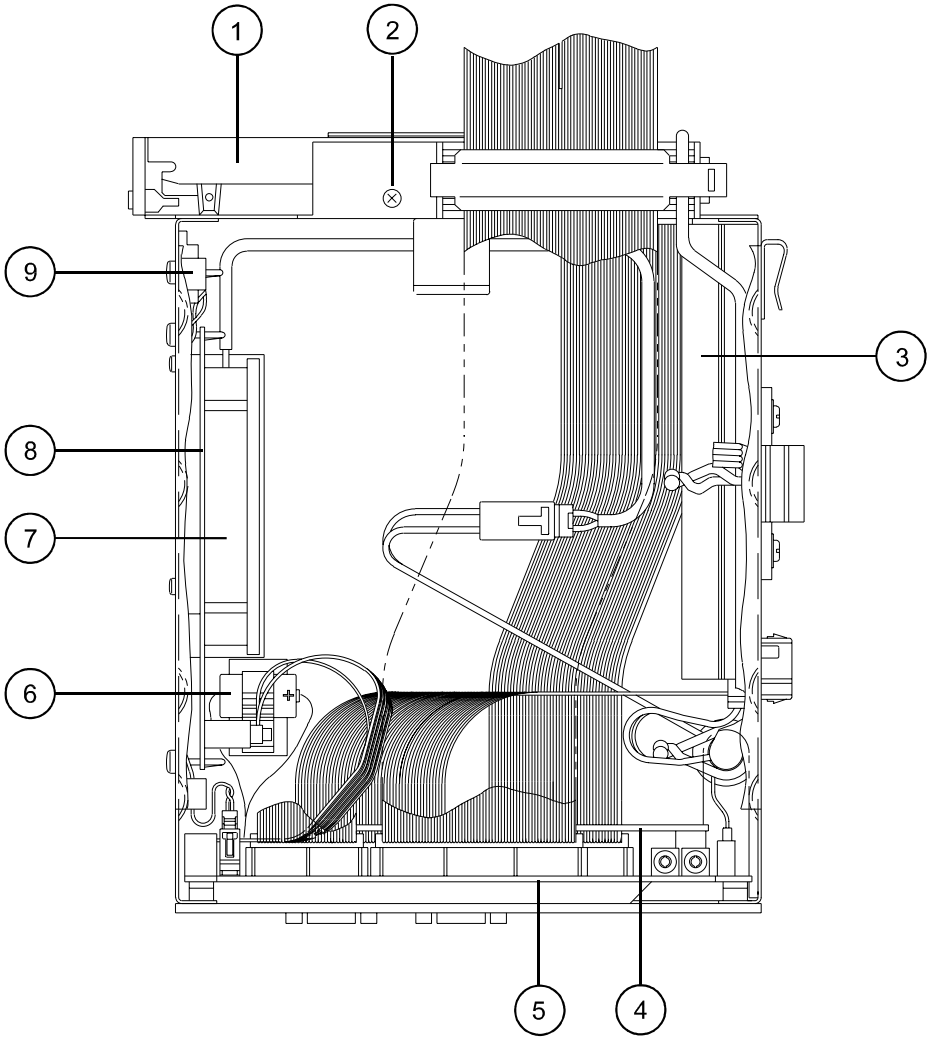


Fig. 6: PC-tower - topview (Printer dismounted)

① ..... Clamping bolt for floppy drive
② ..... Floppy drive
③ ..... Hard disk
④ ..... PC-board B486SLC
⑤ ..... AVLIFB
⑥ ..... Battery
⑦ ..... Fan
⑧ ..... Barcode control
⑨ ..... Buzzer

AVL OMNI™ - front view

Analyzer cover removed, screen dismounted and measuring chamber plate opened up.

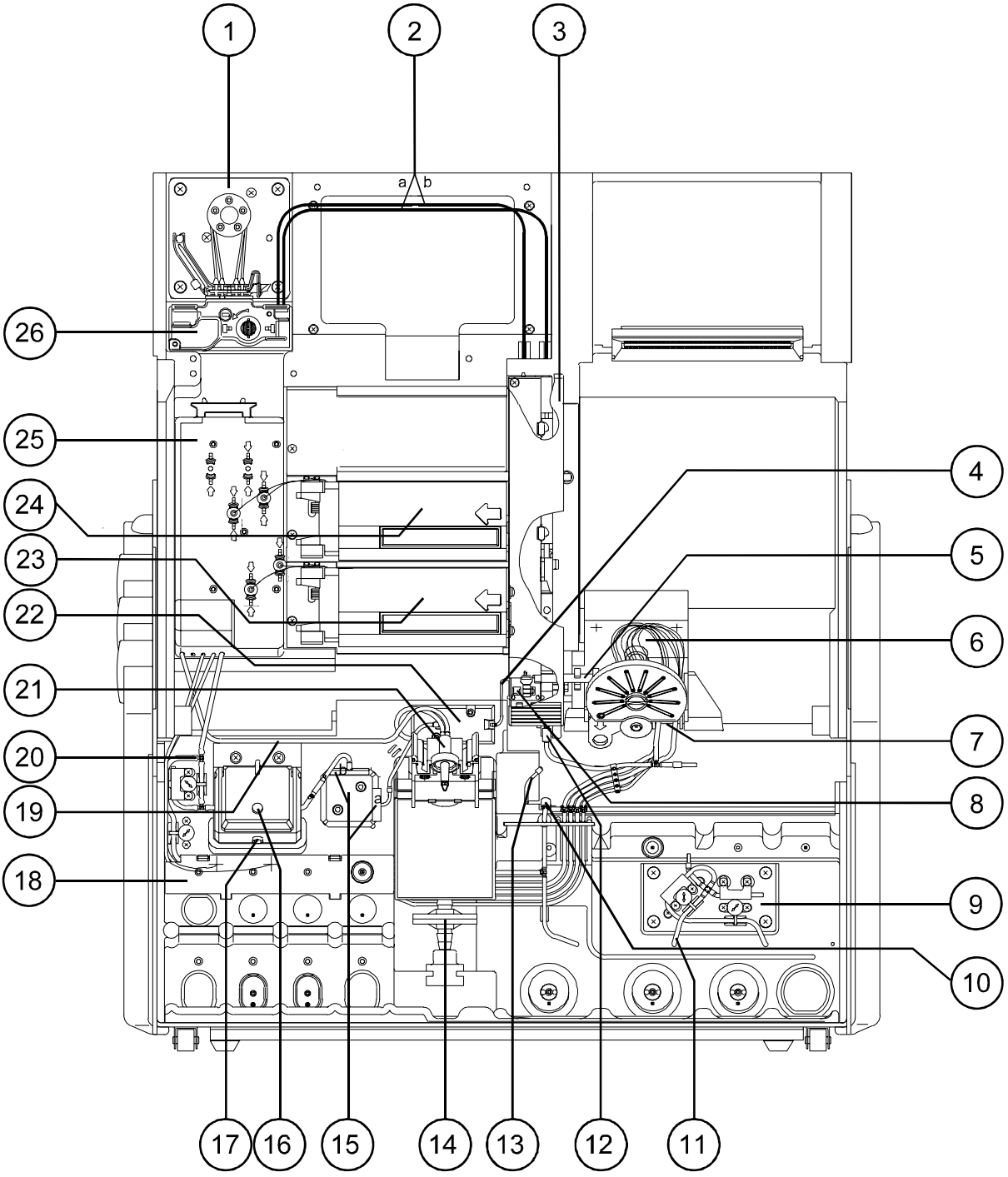


Fig. 7: AVL OMNI™ - front view

① ..... Peristaltic pump
② ..... Tubes to Sample distributer
③ ..... Sample distributer and sample distributer cover
④ ..... Tube from Sample distributer to tHb-cartridge
⑤ ..... T&D-sample inlet path
⑥ ..... T&D-module
⑦ ..... T&D-flap
⑧ ..... Bypass-cartridge
⑨ ..... Fluid mixing system (FMS)
⑩ ..... Line for Solution A
⑪ ..... Connection for Standard B
⑫ ..... Second connection of the line for Solution A
⑬ ..... Bottle pipe III to the Sample distributor
⑭ ..... Bacterial filter
⑮ ..... Hemolyzer and docking flange
⑯ ..... tHb-measuring chamber and securing button
⑰ ..... Measuring chamber releasing button
⑱ ..... Tubing cover
⑲ ..... Waste-tube
⑳ ..... T-piece
㉑ ..... Waste cap T2
㉒ ..... tHb-cartridge
㉓ ..... BG-measuring chamber
㉔ ..... ISE-measuring chamber
㉕ ..... Measuring chamber cartridge
㉖ ..... PP-cartridge

AVL OMNI™ - rear view 1

Screen tiped in forward direction, without PC-tower.

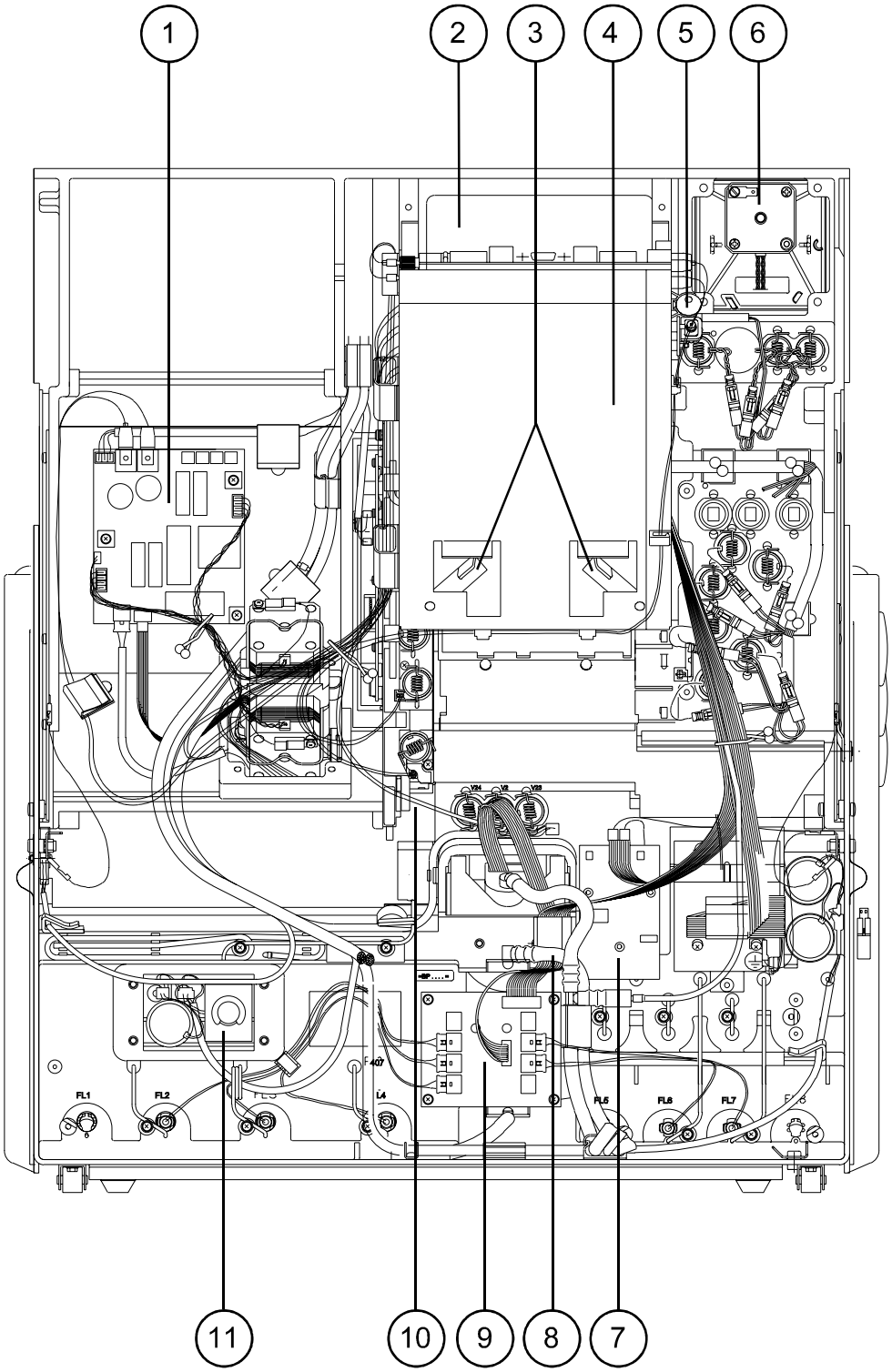


Fig. 8: AVL OMNI™ - rear view 1

① ..... T&D-control
② ..... FLATIF
③ ..... Ejection flaps
④ ..... Fan and filter
⑤ ..... Vacuum sensor
⑥ ..... Peristaltic pump
⑦ ..... Hemolyzer board
⑧ ..... connection tubes to Vacuum pump
⑨ ..... Fluid level detector -Board
⑩ ..... Cable to Sample sensor III
⑪ ..... Fluid mixing system (FMS)

Manual revision 4.0, July 1996

Chapter 2 (revisions).....10-27

modified chapters: all

applicable from software version: 2.0

Summary

Chapter - Page [1]	**Modification/Addition**
Cover page	Increase of revision number from 3.0 to 4.0 Designation Modular System changed to Combi Analyzer
Contents	updated
1	Decontamination added
2-2	Revision nurnber added
3-7	Text added under "Input parameters"
3-8	Text added under "Calculated parameters"
3-11	Solution 3 deleted because of combination of Solutions 3 and 4
4-2	• Installation sequence changed • Relief clamp removal deleted • Text modification under "Installation of PP tubing" because of new PP
4-3	Assembling of FMS tubes added
4-8	Test procedure of PP tubes added
4-6	Option paper take-up unit added
4-7	Fig. 4-7 updated
4-8	Fig. 4-8 updated and note added
4-9	• Fig. 4-9 updated • Shutdown sequence changed
4-10	• Valve cap removal deleted • Text modification under "releasing the pump tubes" because of new PP
5-1	• Text added under "*CAUTION !*" • Sequence of steps 1 - 11 changed
5-2	Addition under "*NOTE*" because of installation position of bacterial filter
5-5	Under "Function", the diameter of the bypass nipple was changed to 1.0 mm and thus its function as clot catcher deleted
5-7, 5-29, 5-90, 5-92,	Solution 3 deleted
5-14	Table of DIL switch assignment on Mainboard updated
5-37, 5-49	Cleaning the cuvette deleted
5-39	Text added under "NOTE" regarding winding up of light guides and light guide marking
5-40 and 5-41	Fig. 5-19 and 5-20 updated to show changed light guide wiring
5-56, 5-62, 5-68	New installation of software added under "Changing the hard disk" and "Changing the entire PC tower"
5-66	Note under "Changing the battery" added

[1] Number of pages revers to Service Manual Rev. 3.0, March 96

5-69	• Manual initialization of FMS calibration deleted and pump tubing test added Text modification because of new peristaltic pump under: "Changing the Peristaltic pump" "Changing the PP head" "Changing the PP tubing set" "Changing the PP cartridge"
6-69, 5-71	• Fig. 5-31 and 5-32 updated because of new PP
5-70	• New PP tubing exchange routine added under "Changing of PP head. Text changed! • Text change and deletion of manual initialization of FMS calibration due to new PP tubing exchange routine
5-74	Fig. 5-34 updated
5-75	Note added under "Changing the sample distributer cartridge"
5-76	Notes added under "Changing the entire sample distributer"
5-77	• Disassembly of screen grid at PC tower under "Changing the thermal printer" added • Text added because of thermal printer adjustment
5-83	Fig. 5-40 updated because of combination of Solutions 3 and 4
5-86	V22 changed from Midi K-A/BP2063 to Midi K-B/BP2064
5-92	Synchronization of bottle R1 and R2 deleted
5-97	Item 2 under "Changing Waste cap T2" deleted
5-108	Fig. 5-49 updated because of new PP
6	Sytem functions updated
7-4	"Preparing Rinse packages in the converting line" added
7-5	Text change under "Measuring cycle"
7-7	Text change under "Aspiration of the sample in the tHb- or COOX measuring chamber"
7-11	Text change under "Cleaning", "Empty Reference electrodes" and "Rinse Reference electrodes"
7-12	Aspiration status codes moved to chapter 9
7-13 to 7-27	• Tubing diagrams updated (combination of Solutions 3 and 4) • Sample sensor SS4 and wash water nozzle added
7-15	Fig. 7-3 updated
8-1	Cleaning of COOX module added
8-2	• "Check brightness of touch screen" under Recommentations added • "Changing the valve tapper and cleaning the valve head" added
8-3	Under "Update of microcontroller software (HS, MM, as well as PX and CCD at AVL OMNI™ 3 and 6)" CCD deleted, since CCD on EPROM
8-4	• "Save On/Off" changed to "Avopto save On/Off" • "Service print On/Off" changed to „Avopto report On/Off“ • Economy mode On/Off, AutoQC On/Off and Hct On/Off added
8-6	• Text added under "Optobus" • "Special shutdown" added
9	Service report added
9-1	Introduction of automatic vacuum error troubleshooting procedure added
9-4	Table for interpretation of T&D errors added
9-10	• "Module error" changed to "System error" • "Rinse error general" added • "Bypass rinse error" and "SD rinse error" added
9-12	Introduction of automatic FMS volume error troubleshooting procedure added
9-16 bis 9-19	• Tubing diagrams updated (combination of Solutions 3 and 4) • Sample sensor SS4 and wash water nozzle added
9-20	"MC cover error BG/MC cover error ISE" added
9-42	Text and Fig. added under "Sample not washed out in measuring module, sample path obstructed"
10	Rev. 4.0 added
11	Figures updated

Chapter 2 (Revisions):

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_3A	**Mainboard**	9700AC1	I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_7B	**MC-heat control**	9700LB4	na
BB0521	Rev_38	**Amplifier POT 9799LP1**	9700LP1	na
BB0532	Rev_11	**MC-ceramic heater**	9700LB9	na
BB0533	Rev_44	**Heat foil**	9700LB3	na
BB0534	Rev_45	**MC-cover heat control**	9700LB8	na
BB0535	Rev_5B	**Amplifier REF 9700LP3**	9700LP3	na
BB0536	Rev_45	**Amplifier AMP 9700LP2**	9700LP2	na
BB0539	Rev_57	**Fluid level detector**	9700LC4	na
BB0542	Rev_9B	**Interface board**	9700CB1	na
BB0548	Rev_58	**T&D-control**	9700LT1	I17: XP0079 CS: $0F61
BB0551	Rev_22	**tHb-board**	9700LB5	na
BB0555	Rev_66	**Motherboard**	9700LC6	na
BB0582	Rev_45	**SD-heat control**	9700LC7	na
BB0584	Rev_02	**BFR-board**	9700LN3	na
BB0630	Rev_04	**Hemolyzer board**	9700LO2	na
BB0648	Rev_11	**Relay board**	9700LCC	I1: XZ0111 CS: $43FE I2: XZ0110 CS: $43DA
BB0651	Rev_11	**T&D-sensor**	9700LT3	na
BB0668	Rev_02	**LCD-converter**	9700LR3	na
BB0657	Rev_02	**Sensorprint Waste**	9700LCD	na
BB0663	Rev_12	**POLYOX-KX-Control**	9700LY3	I21 XP0139 CS: $CC93 I22 XZ0109 (3.01)
BB0662	Rev_00	**POLYOX-Digital**	9700LY2	I5 XP0138 CS: $1318
BB0661	Rev_02	**POLYOX-Analog**	9700LY1	na
BB0725	Rev_00	**POLYOX-Heat**	9700LY4	na
EN0311	Rev_00	**PC MSM486V (PC104)**		
EN0310	Rev_00	**MSMAVL**		
EN0309	Rev_2.5	**B486SLC (AT96)**		
EN0308	Rev_00	**AVLIFB**		
BB0723	Rev_22	**Display IFT**	9700LR7	
BB0722	Rev_22	**Display IFR**	9700LR6	
BB0737	Rev_33	**IFR Comm.-Board**	9700LRA	
EL0273	Rev_00	**TFT LCD-Converter**		

Manual revision 5.0, January 1997

Chapter 2 (Revisions).....10-31

modified chapters: all

applicable from software version: 3.0

Summary

Chapter - Page [1]	**Modification/Addition**
Cover page	Increase of revision number from 4.0 to 5.0
Contents	updated
1-6	Decontamination of AutoQC module outside surfaces added
2-1	Revision numbers updated
3-2	Fig. 3-1 updated
3-3	Text under "AutoQC module" added
3-9	• Duration of 1P calibration changed from 2.5 minutes to 1.5 minutes • Text modification under "Type of measurements"
3-10	Text added under "Type of anticoagulants"
3-11	• Volume of Solution 2 and 4 changed from 30 ml to 25 ml • Deproteinizer and Hb Calibrator added
	AutoQC module under "Dimensions" and "Weight" added
4-10	"Installation of AutoQC module" added
4-4	Installing of the Reference electrode (Ref) and the Junction electrode (Jun) added
4-5	Installation of the AutoQC software added
5	Pre-filter added
5-2	Section "AutoQC module (option)" added
5-9	Valve test under "Changing the FMS" added
5-4	Table of default settings of DIL-switches at Barcode control added
5-23	Note under "Changing the Connector board" added
5-85	Assembly of wash water nozzle added
6	Sytem functions updated
6-4	"check Rule 1 and 2 (On/Off)" under "AVL Multirules" deleted
8-1	• Decontamination of surfaces under "Daily maintenance" added • Changing of the pre-filter under "3-monthly maintenance" added
8-2	• Maintenance of AutoQC module under "Yearly maintenance" added • Cleaning of the Chlorid electrode under "Recommentations" added • Changing of the fluorescent lamps at devices with SN < 1500 under "Yearly Maintenance" added
8-4	• "Backfeed" added • Text modification under "Apply COOX Corrections"
8-5	Text under "AutoQC On/Off" updated
8-6	• Text under "O2-UPol" changed • Function "Delete Data" addded
8-8	Text addition under "Optics test"

[1] Number of pages revers to Service Manual Rev. 4.0, July 96

8-9	"AutoQC" added
9	Error messages added: • "AQC Cover open" • "AQC Wash Error" • "Cl Electrode Dirty (Defect) !" • "Communication Error !" • "AQC SS Error"
9-12	• Interpretation of error codes under "SS error" added • Text addition under "System error"
9-13	• Interpretation of error codes under "Fill sensor error" added • Interpretation of error codes under "Version error" added
9-14	Valve test under "Rinse error general" added
9-46	Text addition under "Scenario 4"
9-47	Text addition under "Scenario 7"
9-50	Additional information under "Optobus error counter" added
10	Rev. 5.0 added
11	Figures updated

Chapter 2 (Revisions):

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_3B	**Mainboard**	9700AC1	I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_7C	**MC-heat control**	9700LB4	na
BB0521	Rev_38	**Amplifier POT 9799LP1**	9700LP1	na
BB0532	Rev_11	**MC-ceramic heater**	9700LB9	na
BB0533	Rev_44	**Heat foil**	9700LB3	na
BB0534	Rev_45	**MC-cover heat control**	9700LB8	na
BB0535	Rev_59	**Amplifier REF 9700LP3**	9700LP3	na
BB0536	Rev_6C	**Amplifier AMP 9700LP2**	9700LP2	na
BB0539	Rev_58	**Fluid level detector**	9700LC4	na
BB0542	Rev_9C	**Connector board**	9700CB1	na
BB0548	Rev_59	**T&D-control**	9700LT1	I17: XP0079 CS: $0F61
BB0551	Rev_22	**tHb-board**	9700LB5	na
BB0555	Rev_66	**Motherboard**	9700LC6	na
BB0582	Rev_45	**SD-heat control**	9700LC7	na
BB0584	Rev_02	**BFR-board**	9700LN3	na
BB0630	Rev_04	**Hemolyzer board**	9700LO2	na
BB0648	Rev_11	**Relay board**	9700LCC	I1: XZ0111 CS: $43FE I2: XZ0110 CS: $43DA
BB0651	Rev_11	**T&D-sensor**	9700LT3	na
BB0668	Rev_02	**LCD-converter**	9700LR3	na
BB0657	Rev_02	**Sensorprint Waste**	9700LCD	na
BB0663	Rev_13	**PolyOx-KX-Control**	9700LY3	I21 XP0139 CS: $CC93 I22 XZ0109 (3.04) CS: $73B6
BB0662	Rev_00	**PolyOx-Digital**	9700LY2	I5 XP0138 CS: $1318
BB0661	Rev_02	**PolyOx-Analog**	9700LY1	na
BB0725	Rev_00	**PolyOx-Heat**	9700LY4	na
EN0311	Rev_00	**PC MSM486V (PC104)**		
EN0310	Rev_00	**MSMAVL**		
EN0309	Rev_2.5	**B486SLC (AT96)**		
EN0308	Rev_00	**AVLIFB**		
BB0723	Rev_22	**Display IFT**	9700LR7	
BB0722	Rev_22	**Display IFR**	9700LR6	
BB0737	Rev_33	**IFR Comm.-Board**	9700LRA	
EL0273	Rev_00	**TFT LCD-Converter**		

Manual revision 6.0, August 1997

Chapter 2 (Revisions).....10-36

Chapter 5 (Function modules from A - Z).....10-37

modified chapters: all

applicable from software version: 4.0

Summary

Chapter - Page [1]	**Modification/Addition**
Cover page	Increase of revision number from 5.0 to 6.0 Text changed from AVL OMNI™ 1 - 6 to AVL OMNI™ 1 - 9
Contents	updated
1-1	Relative humidity of 95% to 70% for MSS added
1-3	Note added
1-5	Decontamination of sample inlet path (item 5) added
1-7	Internal decontamination modified
2-1	Revision numbers updated
2-3	Software versions added
3-1	Text updated because of new AVL OMNI™ types (MSS)
3-2	Fig. 3-1 updated
3-4	Fig. 3-2 updated
3-6	Measurement parameters updated and added
3-8	Osmolality under “Calculated parameters” added
3-9	• Frequency of 2P calibration changed • Calibrations added • Type of measurements added • Sample dates added and updated
3-10	Sample volumes for MSS added
3-11	Solution 1, 3, 5 and D added
3-12 and 3-13	Dates under “Environmental considerations - Instrument, Electrodes, Reagents” updated and added
3-13	Text under “Electrical requirements” added
3-14	Text under “Weight” changed
4-2	Fig. 4-1 updated
4-4	Fig. 4-4 deleted, Fig. 4-5 updated
4-5	• Fig. 4-6 updated • Installation routine changed; Installation of MSS-Ref. contact electrode and the MSS cartridge added
4-6	Fig. 4-7 updated
4-9	• Shutdown procedure modified • Fig. 4-10 updated
4-12	Figure added, Text modified
4-14	Note added

[1] Number of pages revers to Service Manual Rev. 5.0, January 97

4-15	Fastening strap added
5	• Change of AQC optical light guides, AQC power supply cable and AQC wash tube (AQC cable tree) combined • Note added • MSS measuring chamber added
5-1	Text modification and figure added
5-23	Table of default settings of DIL-switches at Barcode control corrected, all switches ON
5-26	• Text under “Changing the container pipes” modified because of additional container pipes (MSS) • Text modification under "NOTE"
5-28	Fig. 5-13 updated
5-29	Text modified
5-31	Text under "Alarm behavior in containers without fill level detection" added and modified
5-33	Text modification under "Following actions to bottle change"
5-35	Text under "Changing the fill level sensors" modified because of additional fill level sensors (MSS)
5-43	Table of DIL switch assignment on Mainboard updated
5-49	Changing of BG measuring chamber modified
5-52	Changing of ISE measuring chamber modified
5-58	Fig. 5-24 updated
5-78	"Changing the optical sensor SS3" added
5-82	Power supply unit: fuse EV0047 (3.15 AT) replaced by EV0158 (2.5 AT)
5-83	• Fig. 5-36 updated • AT96 modifications added; Display IFT is no longer applicable, PC modifications (battery, hard disk, option network connection at AVLIFB added)
5-84, 5-90, 5-97	New display!
5-86, 5-92, 5-96	Note added
5-105	Fig. 5-46 and Fig. 5-47 updated
5-106	Textmodification, note and figure added
5-107	Textmodification because of new measuring chamber (MSS) at item 13, 14 and 16 note added
5-108	"Changing the optical sensors at sample distributor" added
5-110	Fig. 5-50 updated
5-111	SS6 under "Required SS position" added
5-112	Text added under "Determining the software revision" and "Adjustment procedures"
5-114	“Changing the optical sensors SS4 or SS6” added
5-115	Fig. 5-54 a and b updated
5-118	List of valves updated (MSS)
5-130	Fig. 5-61 updated
5-131	Table updated
6	Sytem functions updated
7	• MSS added • Tubing diagrams updated and MSS diagrams added • Text modifications
8-3	Change of contact clip (MSS) under "Yearly maintenance" added
8-5	Software update modified
8-7	Text under "Economy Mode" added
8-8	"Reset MSS Cal." under "Service area" added

9	• "AutoQC: Check Materials !" added • "AQC pos. error" added • "Check MSS Solutions !" added • "Check Date/Time !" added • "Glu is defective" added • "Glu/Lac defective" added • "Glu/Lac defective" added • "MSS: No Sample Detected" added • "MSS polarisation not ok" added • "MSS Temp Error" added • "Sol 4 exhausted !" added • "Poly Cal not OK" added • "Remote Control" added • "Remote Lock" added • "Setup Error" added
9-4	Fig. 9-1 updated
9-5	Text under "FMS error, Scenario 3" changed from bbbb > 3830 to bbbb > 4130 and from bbbb < 2830 to bbbb < 2530
9-7	(tn) FMS time updated
9-15	"MC Cover Error MSS" added
9-19	Fig. 9-6 updated
9-21	Text added under T&D error 48 and 49
9-22	• Text under “T&D error” added • Text under “Temp. error” added
9-27	• Voltage under “AQC SS error”, 3. “Cause(s) / Action(s)” changed from > 20 mV to < 20 mV
9-28	Text under "AQC Wash error” added
9-29	Text under "BG: No Sample Detected” modified and added
9-31	Text under "Check Cond. Solution / Check Zero Solution” added
9-32	Text under "Cl Electrode Dirty (Defect) !” modified
9-35	Text under "COOX: No Sample Detected” added
9-37	• Text under "No Zero Sol” added • Text under "tHb: No Sample Detected” modified and added • "No Zero Sol.” deleted
9-42 and 9-43	Text under "Analyzer does not start up - scenario 4 and 5" added
9-48	Text under "Sample not washed out" combined with "Rinse error general"
9-55	• Report 5 and 6 under "Service report" added • Reports and Tables updates
9-61	Tolerance limit of %CBG/%CISE value changed from 5% to 8%
9-67	Kalibrierparametergrenzen aktualisiert (1P cal./Sigma max. for PO_2 and LFB/Mean max. for BG)
9-66	Values under "Interpretation of FMS times (tn)" updated
10	Rev. 6.0 added
11	Figures updated

Chapter 2 (Revisions):

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_3B	**Mainboard**	9700AC1	I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_7C	**MC-heat control**	9700LB4	na
BB0521	Rev_39	**Amplifier POT 9799LP1**	9700LP1	na
BB0532	Rev_11	**MC-ceramic heater**	9700LB9	na
BB0533	Rev_44	**Heat foil**	9700LB3	na
BB0534	Rev_45	**MC-cover heat control**	9700LB8	na
BB0535	Rev_6A	**Amplifier REF 9700LP3**	9700LP3	na
BB0536	Rev_6C	**Amplifier AMP 9700LP2**	9700LP2	na
BB0539	Rev_58	**Fluid level detector**	9700LC4	na
BB0542	Rev_BE	**Connector board**	9700CB1	na
BB0548	Rev_59	**T&D control**	9700LT1	I17: XP0079 CS: $020F
BB0551	Rev_22	**tHb board**	9700LB5	na
BB0555	Rev_66	**Motherboard**	9700LC6	na
BB0582	Rev_45	**SD heat control**	9700LC7	na
BB0584	Rev_02	**BFR board**	9700LN3	na
BB0630	Rev_04	**Hemolyzer board**	9700LO2	na
BB0648	Rev_12	**Relay board**	9700LCC	I1: XZ0111 CS: $43FE I2: XZ0110 CS: $43DA
BB0651	Rev_11	**T&D sensor**	9700LT3	na
BB0668	Rev_02	**LCD converter**	9700LR3	na
BB0657	Rev_02	**Sensorprint Waste**	9700LCD	na
BB0663	Rev_13	**PolyOx-KX-Control**	9700LY3	I21 XP0139 CS: $CC93 I22 XZ0109 (3.04) CS: $73B6
BB0662	Rev_00	**PolyOx-Digital**	9700LY2	I5 XP0138 CS: $1318
BB0661	Rev_02	**PolyOx-Analog**	9700LY1	na
BB0725	Rev_00	**PolyOx-Heat**	9700LY4	na
EN0311	Rev_00	**PC MSM486V (PC104)**		
EN0310	Rev_00	**MSMAVL**		
EN0309	Rev_2.5	**B486SLC (AT96)**		
EN0308	Rev_6.4	**AVLIFB**		
BB0723	Rev_22	**Display IFT**	9700LR7	
BB0722	Rev_22	**Display IFR**	9700LR6	
BB0737	Rev_33	**IFR Comm.-Board**	9700LRA	
EL0273	Rev_00	**TFT LCD-Converter**		

Chapter 5 (Function modules from A - Z):

PC components

(applicable from SN 1500 to 2560; for SN < 1500, see this chapter under Manual revision 3.0)

PC tower (AT96 with PC B486SLC)

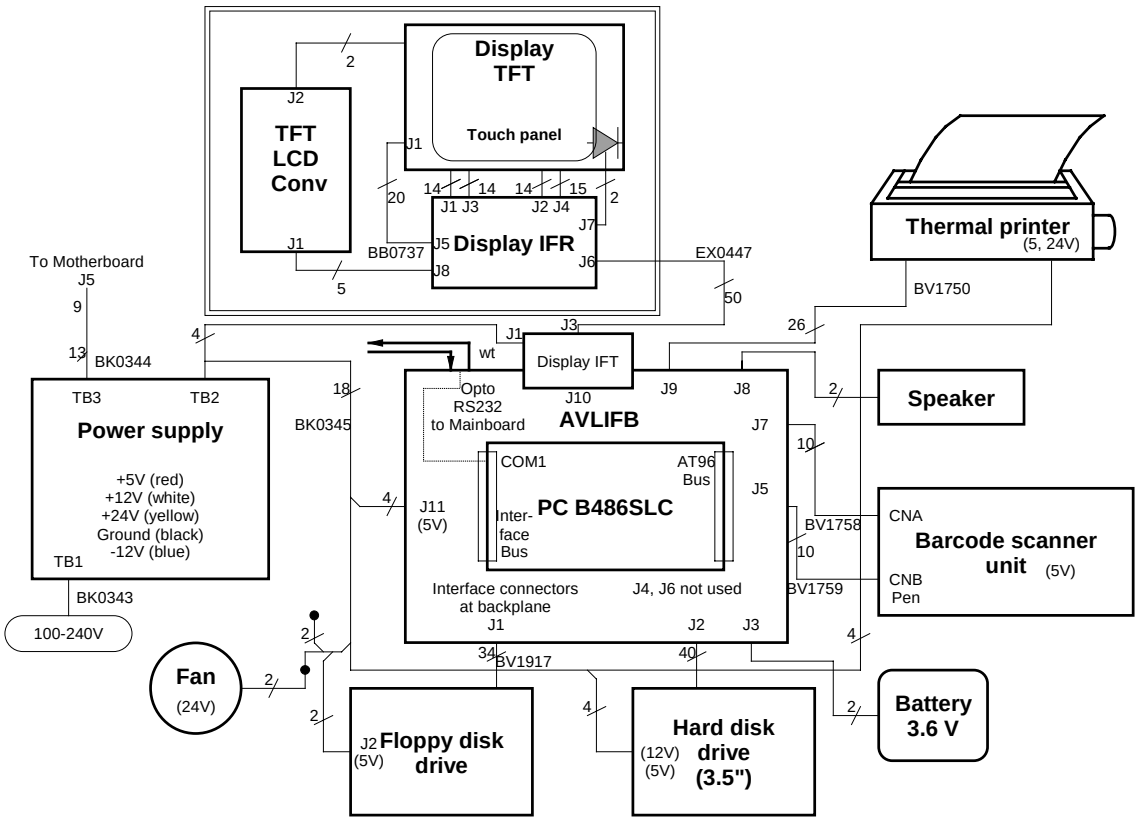


Fig. 1: PC tower (version AT96)

The PC tower of the version AT96 in the AVL OMNI™ includes the following components:

PC board based on the 486SLC
Interface board (AVLIFB)
Display IFT board
Floppy drive
Hard disk 3.5“
Barcode scanner unit
Thermal printer
Speaker
Accu 3.6 V
Power supply unit for the entire AVL OMNI™
Fan (for the PC unit)

The display TFT D321of the AVL OMNI™ has the special advantage of a very large reading angle range of more than +/- 35 ° vertically.
A 50-pole cable connects the display to the AVLIFB (see Fig. 2, **J10**) via the Display IFT board (**J3**).

On the display, the 50-pole cable connects to Display IFR board (**J6**). This card is necessary for the screen keys and the conversion of the screen signals. From the Display IFR board, a 20-pole cable connects to the actual flat screen and a TFT-LCD converter (necessary for background lighting). The Display IFR board contains its own microcontroller which converts the signals from the matrix of the touch panel into serial signals. lt is assembled in the screen housing.

The TFT LCD converter is a transformer and provide the voltage supply for the flourescent lamp, located behind the flat screen in the screen housing.

The hard disk is assembled on the inside of the PC tower, the floppy drive is located on the rear panel (as seen from the rear panel of the analyzer).

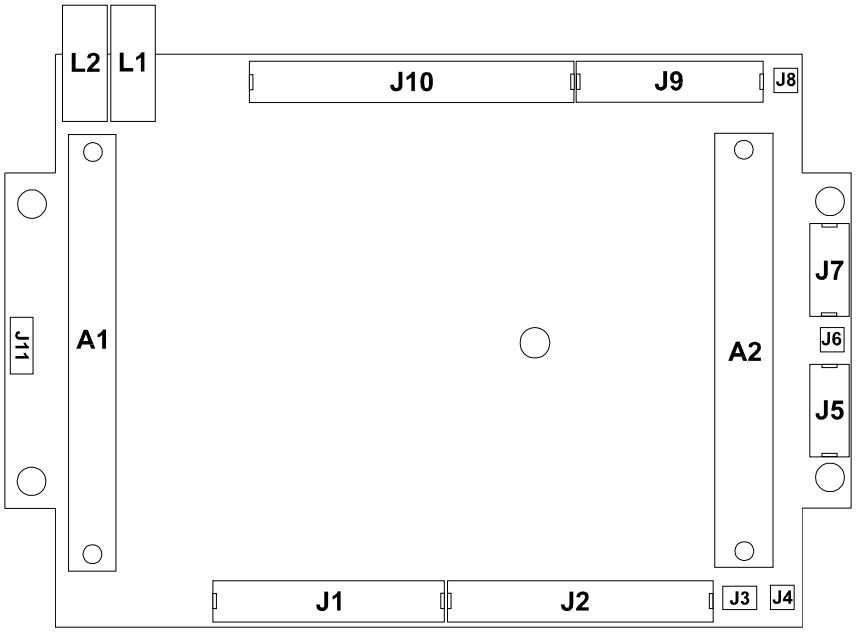


Fig. 2: AVLIFB (1)

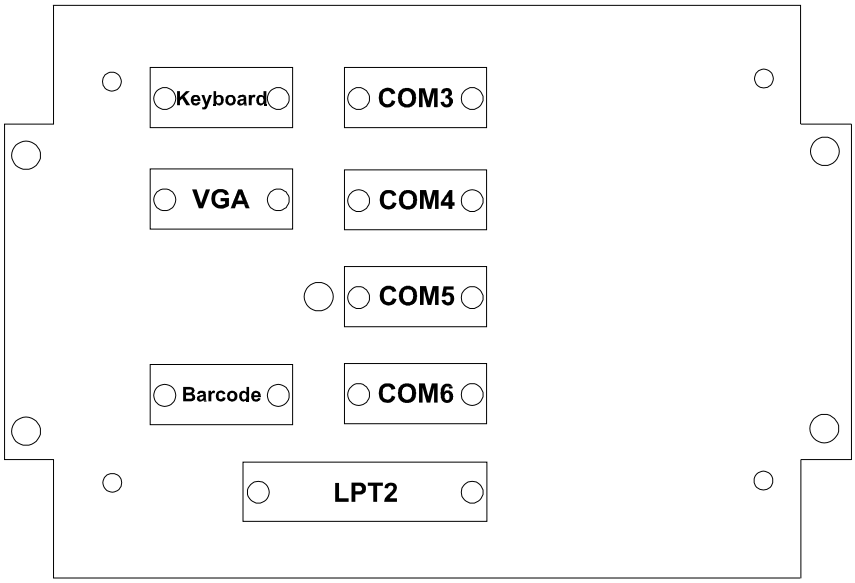


Fig. 3: AVLIFB (2)

PC tower (PC104 with PC MSM486V)

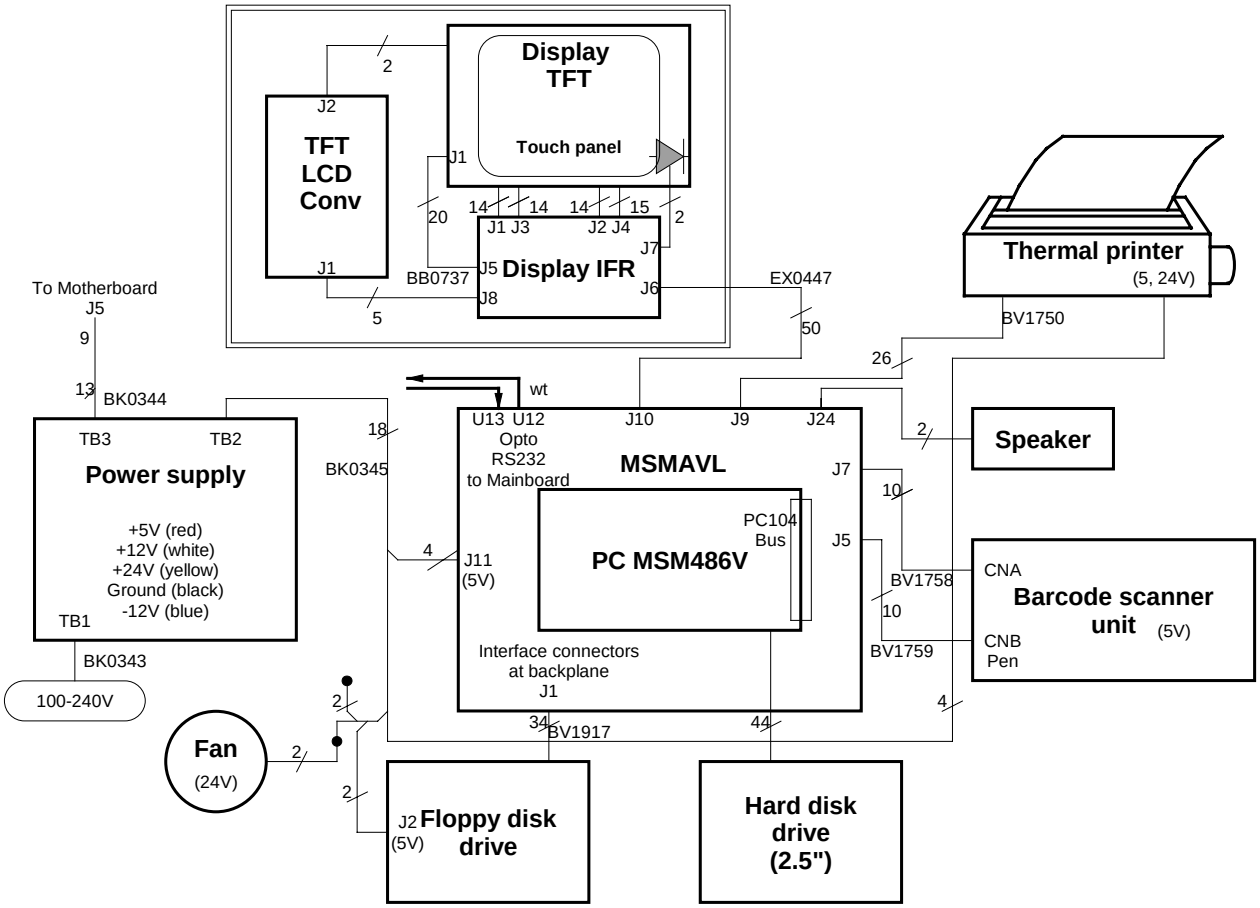


Fig. 4: PC tower (version PC104)

The PC tower of the version PC104 in the AVL OMNI™ includes the following components:

PC board based on the 486V
Interface board (MSMAVL)
Floppy drive
Hard disk 2.5“
Barcode scanner unit
Thermal printer
Speaker
Power supply unit for the entire AVL OMNI™
Fan (for the PC unit)

The display TFT D321of the AVL OMNI™ has the special advantage of a very large reading angle range of more than +/- 35 ° vertically.
A 50-pole cable connects the display to the MSMAVL (see Fig. 5, **J10**).via the card Display IFT (**J3**).

On the display, the 50-pole cable connects to display card IFR (**J6**). This card is necessary for the the screen keys and the conversion of the screen signals. From the Display IFR board a 20-pole cable connects to the actual flat screen and a TFT-LCD converter (required for background lighting).
The Display IFR board contains its own microcontroller which converts the signals from the matrix of the touch panel into serial signals. lt is assembled in the screen housing.

The TFT LCD converter is a transformer and provide the voltage supply for the flourescent lamp, located behind the flat screen in the screen housing.

The hard disk is attached to the PC board MSM486V with spacer bolts, the floppy drive is located on the rear panel (as seen from the rear panel of the analyzer).

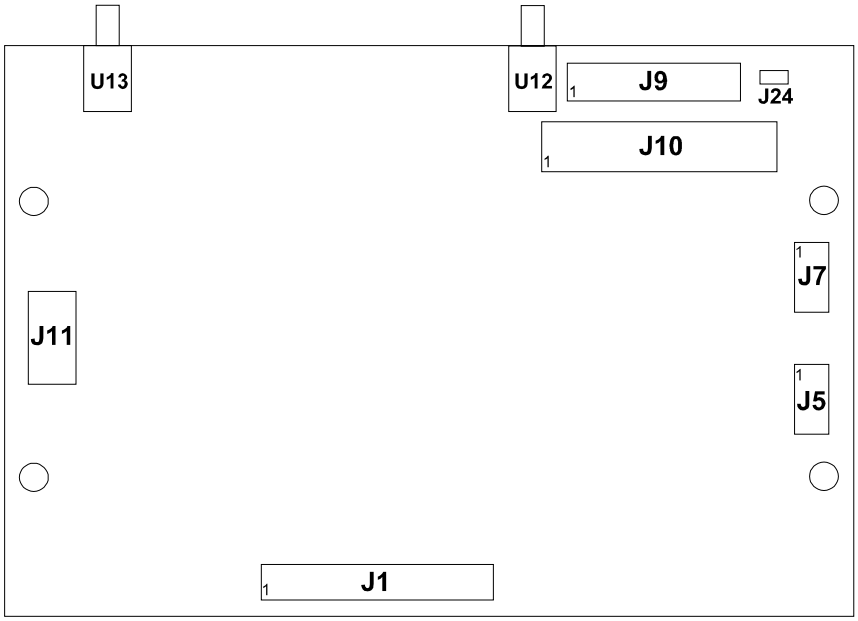


Fig. 5: MSMAVL (1)

Display

The display of the AVL OMNI™ is a TFT LCD - display, type Sharp LQ10D321.

Technical data

Panel size	10.4“
Pixel format	640 x 480
Dot pitch	0.11 x 0.33 mm
Outline dim.	246.5 x 179.4 x 9.5 mm
Active area	211.2 x 158.4 mm
Backlight type	Cold cathodic flourescent tubes (CCFT, dual)
Colors	512
Temperature range	0 to 50 °C
Contrast	100:1
Viewing angle	horizontal: ± 35° vertical: 10°, 30°
Response time	50 ms
Viewing angle optimum	6 o’clock

Changing the entire touch screen

When changing the touch screen, please proceed as follows:

1. Pull the screen forward and remove the 4 Phillips screws to open the screen housing.
2. Remove the Phillips screw from the cable clip and disconnect the 50-pole cable from the screen (see Fig. 6).
3. Pull off both tubes on the sample distributor and remove from the securing clips.
4. The touch Screen can now be disassembled by removing the five Phillips screws.

Assembly is done in reverse order.

NOTE: *Do not exchange the two tubes on the sample distributor when reconnecting.*

Changing the flourescent lamp

When changing the flourescent lamp, please proceed as follows:

1. Pull the screen forward and remove the 4 Phillips screws to open the screen housing.
2. Remove the Phillips screw from the angle bracket and remove the angle bracket (see Fig. 6).
3. Remove the 3-pole connector (see Fig. 6) from the fluorescent lamp and pull the lamp from the housing on the right side.

Assembly is done in reverse order.

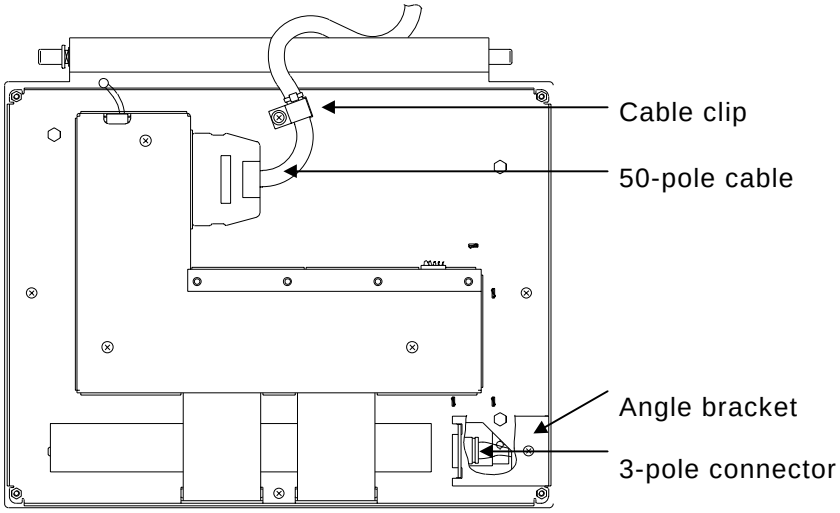


Fig. 6: Display

Manual revision 7.0, May 1998

Chapter 2 (Revisions).....10-47

modified chapters: all

applicable from software version: 4.5

Summary

Chapter - Page [1]	**Modification/Addition**
Cover page	Increase of revision number from 6.0 to 7.0
Contents	updated
all chapters	Text corrections and modifications
1-1	Text added under “Relative humidity”
1-2	added
1-3	ESD protective measures added
2-1, 2-2	Revision number of Mainboard, Motherboard, SSE (MSS)-Mainboard and SSE (MSS) contact print updated
3-7	Text added under “Measurement parameters” (Precision - glucose and lactate)
3-9	Calculated parameters updated (Shunt, OER, avDO$_2$ added)
3-10	2P MSS calibration added and duration of calibration updated
3-11	• Sample dates and calibration times added and updated • Text added under “Sample volumes”
3-13, 3-14	Contents (Sol. 1 - 4) changed from 25 ml to 40 ml
3-15, 3-16	Values of temperature/humitity for instrument and electrodes added (MSS temperature range adjustable between 25 °C and 30 °C)
3-16	Transport conditions of MSS electrodes in original packages changed from 38 °C to 50 °C
4	Options added
4-7 bis 4-8	Installation of MSS cartridge actualized
4-9	item 47: activation of the AQC temperature sensor added
4-19	Fig. 22 updated, temperature sensor added
5	added
5-1	Text added
5-3	Fig. 2 updated, temperature sensor added
5-4	Fig. 3 updated, temperature sensor added
5-5	Temperature sensor added
5-6	Note under “Changing the AQC control board” added
5-16	“Changing the AQC temperature sensor” added
5-17	Fig. 9 updated, temperature sensor added

[1] Number of pages revers to Service Manual Rev. 6.0, August 97

5-22	Table of default settings of DIL-switches at Barcode control actualized
5-52	Text added under “MSS measuring chamber/Function” because of adjustable MSS measuring chamber temperature
5-56	Text added under “Changing the contact clip”
5-97	Text added under “Reinstallation of software”
5-105	“Changing the entire PC tower” actualized
5-146, 5-148	Fig. 71 and 72 actualized
6	Sytem functions updated
7	MSS polarization added
7-3	“Washing and filling of the MSS MC” deleted
7-6	“Washing and filling the MSS measuring chamber with Sol. D” under “Measuring cycle” added
7-10	• Text under “Removal of excess sample into the sample distributor” added • “Washing and filling the MSS measuring chamber with Sol. D” added
7-12	“Washing MSS measuring chamber” deleted
7-14	• “Calculation of calibration and measurement slope” added • “Prepare Int/1P/Slp” transferred to section “ MSS Int/1P/Slp calibration”
7-15	Text under “Start status” actualized
8-1	“Data storage” added
8-2	• “tHb- / COOX calibration” added • “Cleaning of MSS” tubes added
8-5	Text under “Update of the entire software” added
8-6	Text under “Apply COOX Corrections” added
8-7	“MSS-Temp. increased” added
8-8	Text under “Show versions” added
8-10	“Optics test” actualized
8-11	“AutoQC Adjustment” added
9-27	Text under “Version error” added
9-31	• Text under “AQC wash error” added • “AQC Temp. Error” added
9-38	Lamp error 2 added
9-51	“Delayed function key response” added
9-70 bis 9-75	Service report actualized (Header)
9-76	• Measuring flag list actualized • MSS status table added
9-78	Aspiration status codes during measurement actualized
9-81	List of calibration flag actualized
9-84	Calibration parameter limits actualized and new values added

Chapter 2 (Revisions):

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_3B	**Mainboard**		I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_8D	**MC heat control**		
BB0532	Rev_11	**MC ceramic heater**		
BB0533	Rev_44	**Heat foil**		
BB0534	Rev_45	**MC cover heat control**		
BB0539	Rev_58	**Fluid level detector board**		
BB0542	Rev_BE	**Connector board**		
BB0548	Rev_5B	**T&D control**		I17: XP0079 CS: $F9BC
BB0551	Rev_22	**tHb board**		
BB0555	Rev_66	**Motherboard**		
BB0582	Rev_45	**SD heat control**		
BB0584	Rev_02	**BFR board**		
BB0630	Rev_04	**Hemolyzer board**		
BB0648	Rev_12	**Relay board**		I1: XZ0111 CS: $43FE I2: XZ0110 CS: $43DA
BB0651	Rev_11	**T&D sensor**		
BB0657	Rev_02	**Sensorprint-Waste**		
BB0663	Rev_13	**PolyOx-KX-Control**		I21 XP0139 CS: $CC93 I22 XZ0109 (3.04) CS: $73B6
BB0662	Rev_00	**PolyOx-Digital**		I5 XP0138 CS: $1318
BB0661	Rev_02	**PolyOx-Analog**		
BB0725	Rev_00	**PolyOx-Heat**		
EN0311	Rev_00	**PC MSM486V (PC104)**	SN > 1500	
EN0310	Rev_00	**MSMAVL**	SN > 1500	
EN0309	Rev_2.5	**B486SLC (AT96)**	SN > 1500	
EN0329 **EN0336**	Rev_7.3	**AVLIFB** **(with and without network)**	SN > 2566	replaces EN0308 and BB0723
BB0722	Rev_22	**Display IFR**	SN > 1500	
BB0808	Rev_00	**IFR connector board**	SN > 2800	
EL0281	Rev_00	**TFT LCD converter**	SN > 2800	

EN0292	Rev_02	**Power supply unit**		
BB0739	Rev_22	**SSE (MSS) Amp Glu/Lac**		
BB0741	Rev_45	**SSE (MSS)-Mainboard**		
ZM0845	Rev_33	**SSE (MSS) flexprint**		
ZM0804	Rev_33	**SSE (MSS) connector board**		
BB0774	Rev_00	**SSE (MSS) contact print**		

AutoQC (Option)

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BB0760	Rev_12	**AQC control board**		I13: XP0177 CS: $2565 I23: XZ0145 CS: $65E0
BB0771	Rev_00	**YZ-distributor board**		
BB0772	Rev_00	**Z-distributor board**		

Manual revision 8.0, November 1998

Chapter 2 (Revisions).....10-52

Chapter 3 (Description of Functions / Specifications).....10-54

Chapter 5 (Function modules from A – Z) 10-55

Chapter 9 (Troubleshooting).....10-78

modified chapters: all

applicable from software version: 5.0

Summary

Chapter - Page [1]	**Modification/Addition**
Cover page	Increase of revision number from 7.0 to 8.0
Contents	updated
1-10	Cleaning instructions for MSS MC cover added
2-5	Software version added (4.51 and 5.0)
3-1 and 3-2	Urea added
3-5	Fig. 2 updated (hemolyzer, valve wiring)
3-7	Urea under “Measurement parameters” added
3-9	BUN and $SO_{2(c)}$ under “Calculated parameters” added
3-10	• “Type of calibrations” updated • Urea under “Type of measurements” added
3-11	Sample dates and calibration times updated
3-13, 3-14	Reagents for Urea added (Solution 1, 3, 5 and D)
3-16	Storage conditions in original packages for reagents updated
3-18	Acoustic noise level reduced to 55 dB
4-2	Fig. 1 updated
4-3	Item 13 updated, relief clamp no longer necessary
4-4	• Insertion of bottle compartment cover under item 18 added • Fig. 4 updated, PC104 deleted • Possibility of language setup added • Urea activation added
4-5	• Fig. 6 updated • Note added (urea reagents)
4-7	MSS measuring chamber setup added
4-10	Fig. 11 updated
4-11	Item 13 updated, relief clamp no longer necessary
4-12	Text modification under item 20 – installation of AutoQC DemoKit GD0211

[1] Number of pages revers to Service Manual Rev. 7.0, May 1998

4-13	Section „Installation of the AutoQC module“ updated (from SN 5000 on, AQC cable tree is pre-mounted)
4-20	MSS Conditioning System under “Options” added
5	Aerosol trap added
5-24	Text modification under “Barcode scanner”
5-27	Text under “Changing the cable trees, ...” updated: • valve bus added • BK0331, BK0332, BK0334 deleted • BK0333 replaced with BK0348 (cable tree FMS)
5-31	Solution R3 added
5-41	Text modification unter “Changing the FMS”
5-42	• Fig. 18 updated • Text modification because of new hemolyzer, “Changing the quadrings” no longer necessary
5-45	Table of DIL switch assignment on Mainboard updated
5-49	Fig. 21 updated
5-55	• Fig. 25 updated(urea added) • Text modification, Urea added
5-59	“Changing the contact foil” deleted
5-66 und 5-67	MSS Conditioning System under “Changing the MC electrode holder” and “Changing the center seal for MC” added
5-72	Fig. 31 updated (resistor added)
5-82 and 5-83	Fig. 37 and 38 updated; laying of light guides
5-88	Fig. 39 updated
5-97	• Directory structure under “PC components” added • Fig. 46, 47 and 50 transfered to section “Interface bard .....”) • Fig. 44 corrected
5-101	• Fig. 45 corrected • Fig. 46 (network added)
5-102	Note under “Changing the hard disk” modified
5-103	“Reinstallation of software” deleted
5-104	Section “PC tower (PC104 with PC MSM486V)” transfered to chapter 10
5-110	Text addition: interface pin assignment, network connection
5-122	Abb. 55 updated
5-137	Note (2^{nd}) updated
5-140	Fig. under “Vacuum pump” added
5-141	Section “Valves” **NEW** (linear actuators)!
5-144	Fig. 70 updated
5-146, 5-147, 5-150 und 5-151	PC104 transfered to chapter 10
5-152	Fig. 74 updated
5-154	Fig. 75 updated
5-156	Fig. 76 (rear view 2) deleted
5-158	Fig. 77 (bottle compartment – backside of the analyzer open) deleted
6	Sytem functions updated
7	NH4, K and urea added
7-6	“Rinse sample out of the MSS measuring chamber (when prompted)” under “Measuring cycle” deleted
7-14	• „NH4, K and urea“ under “First evaluation” added • Text updated

7-17	Intervals under “Flushing with Solution D .....)” added
7-18	Text addition under “Calibration intervals”
7-19	Section “Repeating the D-cycle” and “Aspiration of Reference solution (with urea only)“ under “Washing and filling the MSS measuring chamber with Sol. D” added
7-26 bis 7-48	• Tubing diagrams updated (Urea added) • Diagram 18: sample removed from sample inlet path
8-2	“Checking the wash water nozzle” transfered to “Unscheduled”
8-3	• “Changing the PP tubing” transfered to “Half yearly maintenance” • „Check smooth movement of PP-head rollers“ under „Yearly maintenance“ added
8-6	“Update of microcontroller software” deleted
8-9	Tex tmodufication under “O2-UPol”
8-11	“Software update” deleted
8-12	“Interference Control On/Off“, “Turbidity Corr. On/Off“ and “Activate/Deactivate Urea“ added
9-11 bis 9-14	Tubing diagrams updated (Urea added)
9	• **NEW** concept for the whole chapter • Section “Valve problems” added
9-4	Fig. 1 (Bottle number) updated, R3 for Urea
9-42	• „Glu/Lac defective“ deleted • „Urea is defective“ added
9-49	• Text addition under “MSS: No Sample Detected”
9-61	Fig. 7 updated (hemolyzer)
9-70	„MSS SOL_D times“ updated
9-81	“MSS Status” updated
9-82	Flag 76, 120 and 121 under “List of measurement flags” added
9-98	“Calibration parameter limits” added
10	Rev. 8.0 added
11	Figures updated

Supplement of April 1999

Chapter - Page	**Modification/Addition**
	INDEX added
2-5	Software version added (5.10)
5-52	Item 8 NEW!
5-142	Valve list updated
5-143	Text under “General information” added
5-147 to 5-151	Spacer replaced by spindle adapters
6-4	ASTM under “Settings” added
6-8	updated
7-14	Text correction
8-3	“Changing the valve tapper and cleaning the valve head“ under „Yearly maintenance“ cancelled
8-6	Text correction
9-1	“Date Invalid ! Please Set Date/Time” added
9-21	Text addition under “SS error”; the error code will be printed on the service report
9-32	Text addition under “AQC pos. error”; the error code will be printed on the service report
9-107	Header under “List of calibration flags” corrected
9-112	NH4 limits for slope and interference updated

Chapter 2 (Revisions):

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_6E	**Mainboard**		I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_8D	**MC heat control**		
BB0532	Rev_11	**MC ceramic heater**		
BB0533	Rev_44	**Heat foil**		
BB0534	Rev_45	**MC cover heat control**		
BB0539	Rev_58	**Fluid level detector board**		
BB0542	Rev_BE	**Connector board**		
BB0548	Rev_5B	**T&D control**		I17: XP0079 CS: $EE78
BB0551	Rev_22	**tHb board**		
BB0555	Rev_67	**Motherboard**		
BB0582	Rev_45	**SD heat control**		
BB0584	Rev_02	**BFR board**		
BB0630	Rev_04	**Hemolyzer board**		
BB0648	Rev_12	**Relay board**		I1: XZ0111 CS: $43FE I2: XZ0110 CS: $43DA
BB0651	Rev_11	**T&D sensor board**		
BB0657	Rev_02	**Sensorprint-Waste**		
BB0663	Rev_13	**PolyOx-KX-Control**		I21 XP0139 CS: $CC93 I22 XZ0109 (3.04) CS: $73B6
BB0662	Rev_00	**PolyOx-Digital**		I5 XP0138 CS: $1318
BB0661	Rev_02	**PolyOx-Analog**		
BB0725	Rev_00	**PolyOx-Heat**		
EN0311	Rev_00	**PC MSM486V (PC104)**	SN > 1500	
EN0310	Rev_00	**MSMAVL**	SN > 1500	
EN0309	Rev_2.5	**B486SLC (AT96)**	SN > 1500	
EN0329 **EN0336**	Rev_7.3	**AVLIFB (AT96)** **(with and without network)**	SN > 2566	replaces EN0308 and BB0723
BB0722	Rev_22	**Display IFR**	SN > 1500	
BB0808	Rev_00	**IFR connector board**	SN > 2800	
EL0281	Rev_00	**TFT LCD converter**	SN > 2800	

EN0292	Rev_02	**Power supply unit**		
BB0739	Rev_22	**SSE (MSS) Amp Glu/Lac**		
BB0741	Rev_46	**SSE (MSS)-Mainboard**		
ZM0845	Rev_33	**SSE (MSS) flexprint**		
ZM0804	Rev_33	**SSE (MSS) connector board**		
BB0774	Rev_01	**SSE (MSS) contact print**		

AutoQC (Option)

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BB0760	Rev_12	**AQC control board**		I13: XP0177 CS: $2565 I23: XZ0145 CS: $65E0
BB0771	Rev_00	**YZ-distributor board**		
BB0772	Rev_00	**Z-distributor board**		

Chapter 3 (Description of Functions / Specifications):

AVL OMNI™ - Wiring and wiring without PC (up to SN 5000)

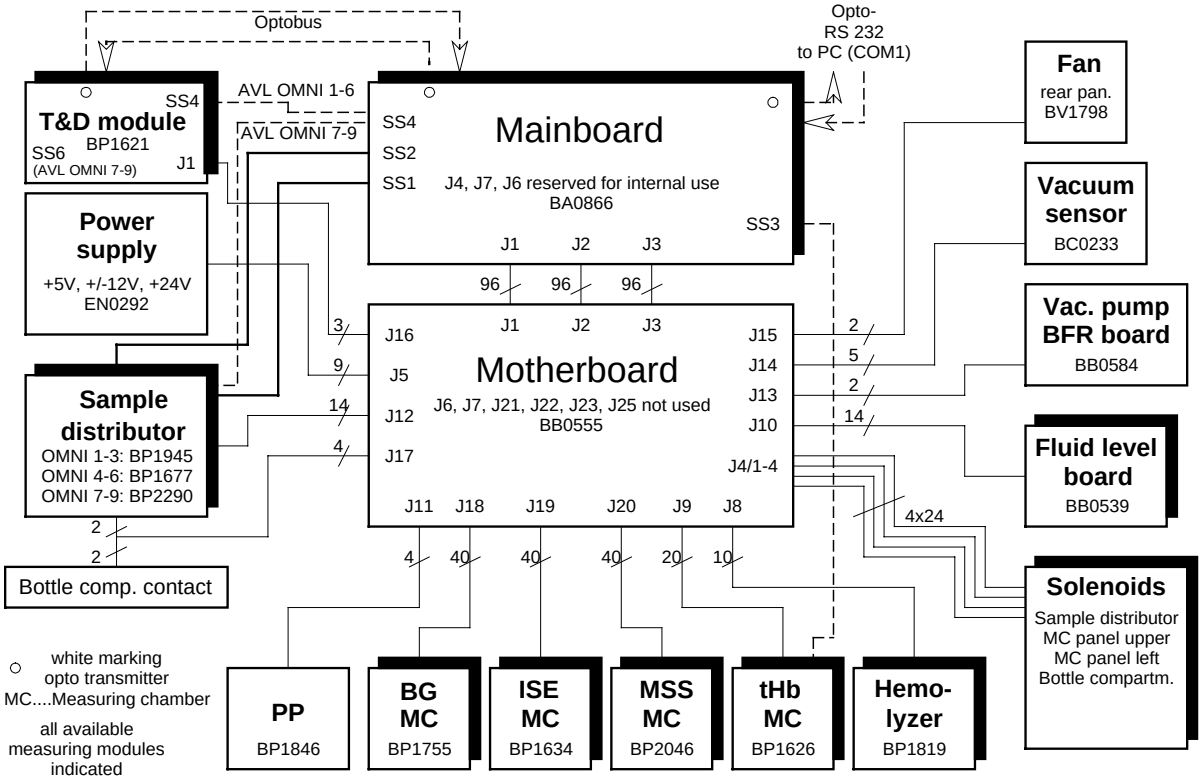


Fig. 1: AVL OMNI™ - Internal wiring

Chapter 5 (Function modules from A – Z):

Hemolyzer *(up to serial number 5000)*

Function

Before the actual measurement, the erythrocytes are destroyed with an ultrasonic hemolyzer to allow measurement of a homogeneous colored solution.

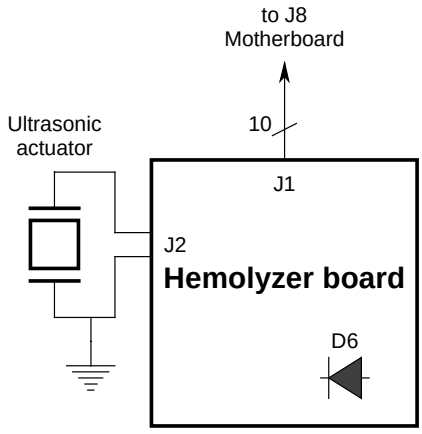


Fig. 2: Hemolyzer

The hemolyzer consists of a resonator as well as the respective control (Hemolyzer board). The power supply for the quarz resonator is generated on this board. The activation takes place on the Mainboard, the green LED D6 (on the Hemolyzer board, see Fig. 5-33) provides a function control.

Changing the hemolyzer

When changing the hemolyzer (see Fig. 10, **15**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Pull off the tubes from the hemolyzer.
4. Remove the cover of the hemolyzer by unscrewing the allen head screws.
5. Gain access to the rear of the analyzer.
   Unplug **J8** from the Motherboard.
6. Disconnect the grounding from the hemolyzer.
7. In order to remove the hemolyzer from the analyzer, loosen both Phillips screws on the front of the analyzer.

Assembly is done in reverse order.

NOTE: *When assembling the hemolyzer, the securing screws are to be tightened alternately to prevent canting.*

Changing the quadrings

When changing the quadrings, please proceed as follows:

1. Activate the program "**System**" to stop analyzer.
2. Open the cover of the analyzer and remove it in an upward direction.
3. Open the bottle compartment cover.
4. Disconnect the tubing from the hemolyzer.
5. Remove the cover of the hemolyzer by unscrewing both Phillips screws.
6. Change the large quadring on the hemolyzer block.
7. Unscrew the docking flange (see Fig. 10, **15c**) from cover and change the small quadring.
8. Unscrew the ledge from the cover (see Fig. 10, **15d**) and change small quadring.

NOTE: *Remove the quadring with the help of tweezers and pay attention to the proper positioning of the new quadring.*

NOTE: *Do not use a sharp edged pair of tweezers to remove the tubing.*

Components from the AVL OMNI™ such as tubing, Waste container, fill port etc. contain biological fluids after use, resulting in possible risk for infections. Handle these components carefully, and avoid contact with the skin. Use rubber gloves.

The tubes may drip a little after being disconnected. Remove excess fluids with a clean, absorbent cloth.

Assembly is done in reverse order..

Call up the function "**Options - Wash**".

Changing the Hemolyzer board

Electrostatic Sensitive Device

When changing the Hemolyzer board (see Fig. 11, **7**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Disconnect cable from the Hemolyzer board.
5. Remove the 3 allen head screws.

Assembly is done in reverse order.

Mainboard (up to software-revision number < 4.5)

Description of the DIL switch and LED's on the Mainboard

The following description is valid from the hardware version Rev.25 and from the software version HS 2.427, MM 2.412.

NOTE: *All switches are to be set at **OFF** for normal operation.*

Main control HS (left row, seen from the rear):

Rocker switch 1	OFF	µC- ON-CHIP-EMULATION-MODE (deactivated)
2	---	not used
3	---	not used
4	---	not used
5	---	not used
6	OFF	burn-in test (deactivated)
7	OFF	OMNI tester - switch test (deactivated)
8	OFF	OMNI tester - switch test (deactivated)

Measuring module control MM (right row, seen from the rear):

Rocker switch 1	OFF	µC- ON-CHIP-EMULATION-MODE
2	---	not used
3	---	not used
4	OFF	warm up with MC overheating activated
5	---	not used
6	---	not used
7	OFF	OMNI tester - switch test (deactivated)
8	OFF	OMNI tester - switch test (deactivated)

PC tower with PC104 (up to serial number 2565)

PC tower (PC104 with PC MSM486V)

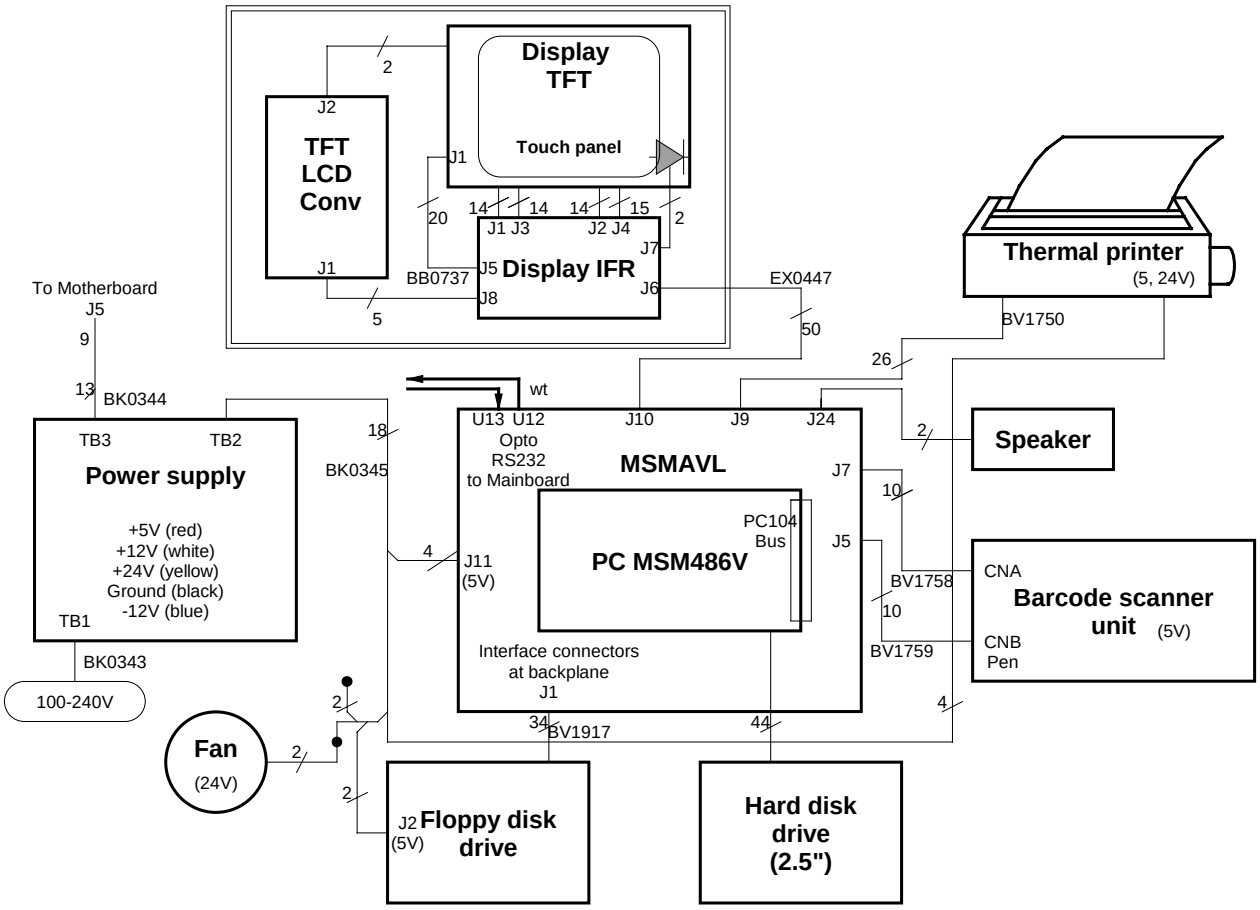


Fig. 3: PC tower (version PC104)

The PC tower of the version PC104 in the AVL OMNI™ includes the following components:

PC board based on the 486V
Interface board (MSMAVL)
Floppy drive
Hard disk 2.5“
Barcode scanner unit
Thermal printer
Speaker
Power supply unit for the entire AVL OMNI™
Fan (for the PC unit)

The display TFT LQ10D42 (with 2 cold cathodic fluorescent tubes) has the advantage of a high brightness and a very large reading angle range of more than +/- 35 ° vertically.
A 50-pole cable connects the display to the MSMAVL (see Fig. 4, **J10**).via the card Display IFT (**J3**).

On the display, the 50-pole cable connects to display card IFR (**J6**). This card is necessary for the screen keys and the conversion of the screen signals. From the Display IFR board a 20-pole cable connects to the actual flat screen and a TFT-LCD converter (required for background lighting).
The Display IFR board contains its own microcontroller which converts the signals from the matrix of the touch panel into serial signals. lt is assembled in the screen housing.

The TFT LCD converter is a transformer and provides the voltage supply for the fluorescent lamp located behind the flat screen in the screen housing.

The hard disk is attached to the PC board MSM486V with spacer bolts, the floppy drive is located on the rear panel (as seen from the rear panel of the analyzer).

PC board "MSM486V"

The basic part of the PC is a PC board of type MSM486V.
The single printed circuit board PC MSM486V contains complete PC electronics, including storage and driver for the floppy drive, hard disk, printer and flat screen. It is connected on the MSMAVL with 7 plug ledges (PC104 bus, floppy disk drive, LPT1, LPT2, VGA, etc.). This is fastened to the rear panel of the PC tower (see Fig. 7, **5**) and includes the necessary interface-expansion with the corresponding plug connectors which are located on the rear panel of the analyzer.
The Barcode control (see Fig. 7, **7**) serves as an interface between the barcode scanner (connected on the rear panel with its own plug connector) and the PC and is assembled on the left side panel of the PC tower (as seen from the rear panel).
The printer module has a parallel Centronix interface and is connected to the respective PC interface. It is assembled on the PC tower.

The PC board MSM486V consists of:

- two serial interfaces (TTL gauge) COM1 (interface for main control) and COM2 (interface for touch screen)
- a parallel interface designed as PS/2 compatible LPT1 (internal printer)
- a VGA compatible Local bus video interface for:
  – analog monitors
  – active color LCD
- 512 kB video RAM
- a keyboard interface for standard PC/AT keyboards
- a floppy drive interface for two 3.5" floppy drives
- a hard disk interface for two IDE hard disk drives
- a real time clock with externally buffered CMOS-RAM (128 Byte)
- 4 MB working storage no parity
- a CPU 486SLC2 with 50 MHz systemclock
- a PC/AT Motherboard logic (DMA controllers, interrupt controllers, one timer and one DRAM controller)
- a BIOS.

The signals from the peripherals are transmitted to the board MSMAVL via 5 pin connectors, the BUS signals from the PC104 BUS are transmitted via a 104 pin PC 104 connector.

Changing the PC board MSM486V

Electrostatic Sensitive Device

When changing the PC board (see Fig. 7, **4**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove the 2 Phillips screws (see Fig. 6, **10**) securing the power supply unit.
5. Remove the 3 Phillips screws (see Fig. 6, **a**, **b**, **c**) securing the PC unit (MSMAVL, PC board MSM486V and panel), slightly lift the PC unit and carefully swivel it to the side.
6. Remove the hard disk (see Fig. 6, **3**) and its carrier plate.
7. Remove the 4 spacer bolts and the PC board.

Assembly is done in reverse order.

Changing the Interface board "MSMAVL"

Electrostatic Sensitive Device

The changing of the Interface board (see Fig. 7, **5**) is done in the same manner as the changing of the PC board, see above.

1. Disconnect all cables from the PC unit.
2. Remove the 4 Phillips screws securing the interface board MSMAVL to the panel (see Fig. 6, **d**, **e**, **f**, **g**).
3. Remove the 16 spacer bolts and EMC seals from the connectors.

Assembly is done in reverse order.

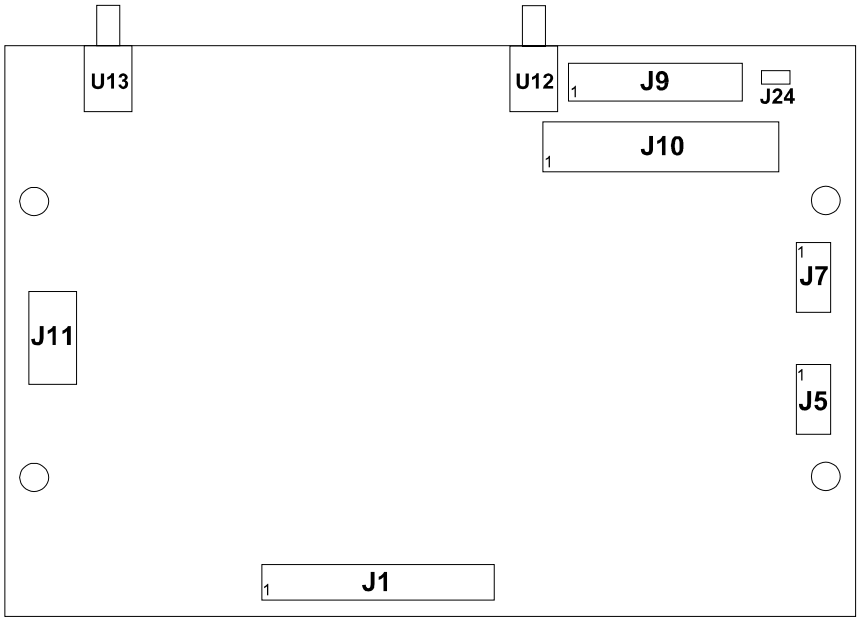


Fig. 4: MSMAVL

Changing the hard disk

Electrostatic Sensitive Device

NOTE: *Before you start with exchange, try to save all important values (e.g. calibration values under "**Data Manager - Cal. - More - Backup/Restore**").*

When changing the hard disk (see Fig. 7, **3**), please proceed as follows:

1. Switch off the AVL OMNI™.
2. Follow the steps 1. to 10. on page 5-2 (with the exception of 2.), under "General information on assembly and disassembly of components".
3. Gain access to the rear of the analyzer.
4. Remove the 2 Phillips screws (see Fig. 6, **10**) securing the power supply unit.
5. Remove the 3 Phillips screws (see Fig. 6, **a**, **b**, **c**) securing the PC unit (MSMAVL, PC board MSM486V and panel), slightly lift the PC unit and carefully swivel it to the side.
6. Disconnect the flat cable from the hard disk.
7. Remove the hard disk (see Fig. 7, **3**) and its carrier plate.
8. Disassemble hard disk from carrier plate.

Assembly is done in reverse order.

NOTE: *When reassembling the hard disk, please take care that the red line of the flat cable is positioned next to the power supply. Further, pay attention that the supply line from the thermal printer is not exchanged with that of the hard disk (plug labeling).*

After replacement of the hard disk, restore data manager data (if possible), customer settings and instrument-specific values (O2-UPol, Baro S value, actual barometric pressure, COOX offset values, sample counter, hotline number, serial number, AutoQC serial- and revision number as well as number of total measurements) and perform a software update (see Chapter 8, section “Software update and Service area”).

*Data previously saved by the operator can be restored in the menu "**Data Manager - Maintenance - More - Restore**".*

Interface board "MSMAVL"

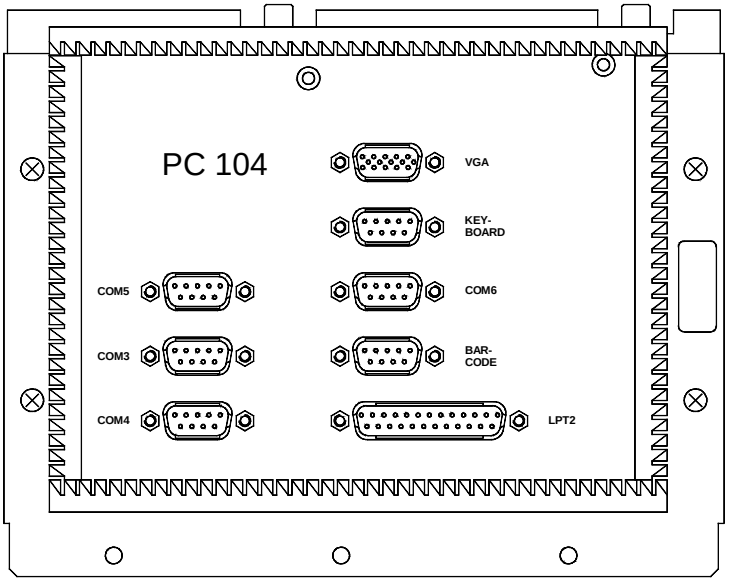


Fig. 5: Interfaces

The AVL OMNI™ is equipped with four serial interfaces (COM 3, COM 4, COM 5 and COM 6) for data transfer one printer interface (LPT2) and further interfaces (keyboard, barcode, etc.).

NOTE: *To prevent damage to the AVL OMNI™, it is necessary to compare the pin assignment of the AVL OMNI™ with that of the customer device (e.g. barcode scanner, barcode reader, external keyboard, terminal, etc.), before connecting these to the AVL OMNI™.*
AVL will not be liable for any damage resulting from nonobservance of this prerequisite.

For details about interfaces, please refer to AVL OMNI™ Operator's Manual, chapter "Interfaces".

Photoconductor interface on COM1

The transmit- and receive signals of the serial interface COM1 of the PC board are designed as optical interface.
Only transmit- and receive-signals from the TTL level on light or from light on the TTL level are converted.
These TTL signals are shown over LED's for control purposes.

Touch panel interface on COM2

The signals of the touch panels are carried on the receive input of the serial interface COM2.

Serial interfaces COM3, COM4, COM5, COM6

Two IBM compatible multifunctional building elements, each with two serial interfaces and one printer interface, are integrated on the MSMAVL. On the one hand, the signals of the PC104-bus are transferred to these building elements, on the other, the signals of the serial interfaces are conducted over the RS232/V24 level converter on 9-poled SUB MIN D-bush. The signals of the printer interface are carried out. This printer board can be reached as a LPT2 (see bellow).

Pin assignment

Pin 1	DCD	Data carrier detected
Pin 2	RxD	Receive data
Pin 3	TxD	Transmit data
Pin 4	DTR	Data terminal ready
Pin 5	GND	Signal ground
Pin 6	DSR	Data set ready
Pin 7	RTS	Request to send
Pin 8	CTS	Clear to send
Pin 9	RI	Ring indicator

Keyboard and barcode scanner interface

The barcode scanner used allows the mixed operation of the scanner unit together with a standard PC/AT-keyboard. To assure this operation, the signals from the keyboard are carried out by an external connection "**Keyboard**" on the connector J7.
The signals of the scanner unit are carried out over the external connection "**Barcode**" on the connector J5 (see Fig. 4).

Pin assignment – keyboard

Pin 1	CLK	clock
Pin 2	Data	
Pin 4	GND	Signal ground
Pin 5	Vcc	+ 5V

Pin assignment – barcode scanner

Pin 1	Vcc	+ 5V
Pin 2	Data	
Pin 3	GND	Signal ground

Printer interface LPT1 and LPT2

The AVL OMNI™ integrated printer is connected to the computer over the connector J9 on the logical interface LPT1. The signals of the second thermal printer board are ranked as LPT2 on the external connection "**LPT2**" (see Fig. 4 and Fig. 5).

Flatdisplay interface

The signals of the active color LCD´s are carried by the 128-poled VG-ledge A2 on a 50-poled SCSI-2-cable (J10) (see Fig. 4).

Analog VGA interface

The transfer of the color signals to an external screen takes place over this interface (15-poled SUBMIN D). When an external screen is connected, the touch screen of the AVL OMNI™ is inactive, if the external screen was connected before turning on the AVL OMNI™.

PC tower - rear view (version PC104)

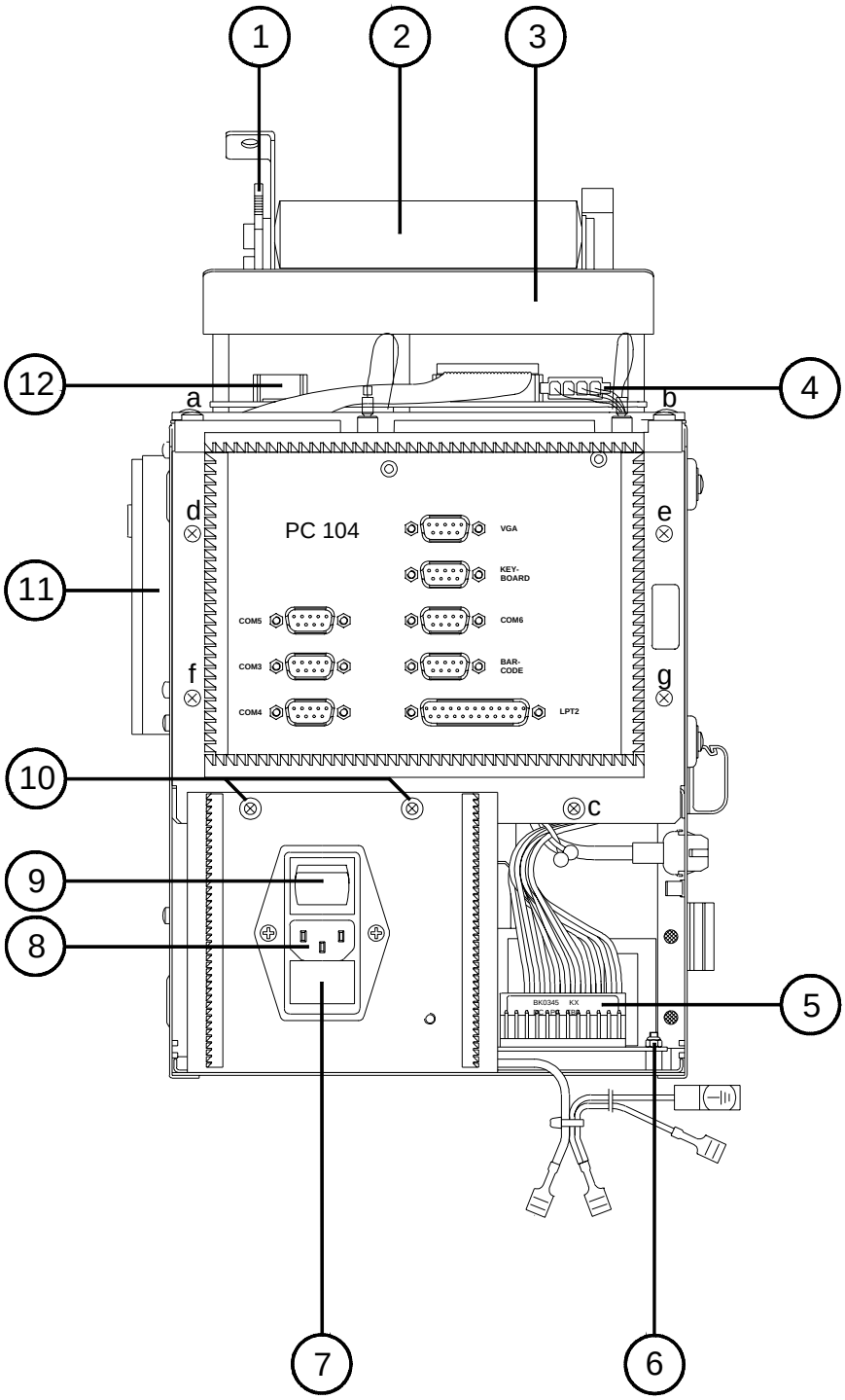


Fig. 6: PC tower / rear view (version PC104)

① ..... Printer lever
② ..... Paper roll axis
③ ..... Thermal printer
④ ..... Power supply - thermal printer
⑤ ..... Power supply - AVL OMNI™
⑥ ..... Fastening screw for power supply unit
⑦ ..... Fuses
⑧ ..... Power supply
⑨ ..... Main switch
⑩ ..... Fastening screws for power supply
⑪ ..... Floppy drive
⑫ ..... Printer dataline

PC tower - topview (version PC104)

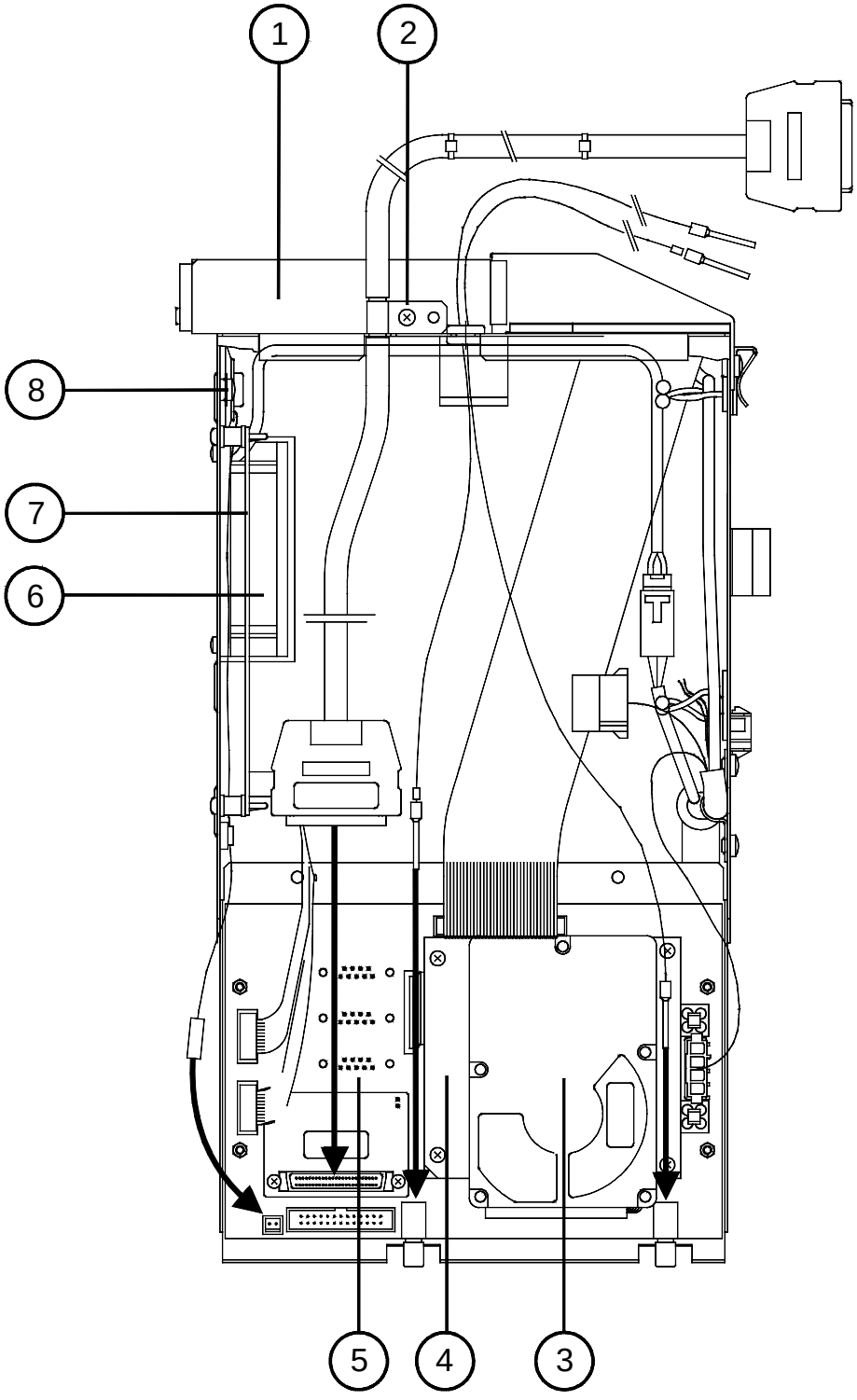


Fig. 7: PC tower / topview (version PC104 / printer disassembled)

① ..... Floppy drive
② ..... Fastening screw for floppy drive
③ ..... Hard disk
④ ..... PC board MSM486V
⑤ ..... MSMAVL
⑥ ..... Fan
⑦ ..... Barcode control
⑧ ..... Buzzer

Valves (up to serial number 5000)

Wiring of the bistable magnetic valves

Four cable trees to four groups of magnetic valves lead from the Motherboard. They are connected at J4/ 1-4. Depending upon the required strength desired, 4 different types of bistable magnets are available (Midi, Midi L (delayed), Maxi A und Maxi B) as well as a monostable magnet.
The control of the bistable magnets is provided by electrical impulses, whereby a positive impulse closes the magnet and a negative impulse reopens it. Therefore, energy for switching is only needed briefly and prevents unecessary warming. In addition the valves are controlled sequentially to prevent overloading of the power supply unit.

Location	Valve no.	Valve type	Id. no.	Motherboard plug no.	Cable tree no.
Measuring chamber plate					
	V5	Midi K-B	BP2064	J4/2	BK0332
	V7	Midi K-B	BP2064		
	V8	Midi K-B	BP2064		
	V9	Midi K-B	BP2064		
	V10	Midi K-B	BP2064		
	V11	Midi K-B	BP2064		
	V14	Midi K-A	BP2063	J4/1	BK0331
	V15	Midi K-A	BP2063		
	V16	Midi K-A	BP2063		
	V17	Maxi B	BP1616		
	V26 = VBO	Midi K-B	BP2064		
	V28 = VIO	Midi K-B	BP2064		
	V30 = VSO	Midi L	BP1799		
Bottle compartment					
	V2 [1]	Midi K-A	BP2063	J4/3	BK0333
	V3	Maxi A	BP1614		
	V4 [2]	Maxi B (A)	BP1614 and (BP1616)		
	V13	Maxi B	BP1616		
	V19	Maxi B	BP1616		
	V23 [1]	Midi K-A	BP2063		
	V24 [1]	Midi K-A	BP2063		
	V mix	FMS-valve	BP1644		
Sample distributor					
	V20	Midi	BP2064	J4/4	BK0334
	V21	Midi K-B	BP2064		
	V22	Midi K-B	BP2064		
	V25 = VBI	Midi L	BP1799		
	V27 = VII	Midi L	BP1799		
	V29 = VSI	Midi	BP1799		

[1] In analyzers with tHb-or COOX module the tHb cartridge is occupied with V2, V23 and V24. In analyzers without tHb-or COOX modules the tHb cartridge is replaced by the BC cartridge, whereby only V23 is occupied.

[2] Maxi A (BP1614) at AVL OMNI™ 1, 4 and 7
Maxi B (BP1616) at AVL OMNI™ 2, 3, 5, 6, 8 and 9

Changing the valves

Please see the tubing diagram in Chapter "Functional procedures" for the valve positions.

General information

When changing the valves please follow the steps 1. to 10., chapter 5, page 5-1 (with the exception of 6), under "General information on assembly and disassembly of components".
Valve V17 and Mix are exceptions. To remove V17 the PP cartridge must be disassembled (see chapter 5, "Changing the PP cartridge").
To remove the Mix valve the FMS system must be disassembled (see chapter 5, "Changing the FMS").

Changing the Midi- and Midi L - valves

Remove the corresponding plug from the valve and press the holding spring towards the side.

Assembly is done in reverse order.

Changing Maxi A, Maxi B and Mix-valve(s)

When changing the Maxi A, Maxi B and Mix-valve(s), please proceed as follows:

1. Disconnect the corresponding plug from the valve.
2. (At Maxi B - valves, loosen both Phillips screws and remove the valve head, see Fig. 8).
3. Remove the valve cap (see Fig. 8), by pressing down firmly.
4. Remove the clamping part (see Fig. 8).
5. Open both securing screws.
6. Remove the shock absorbing ring, the valve plate and the valve head (Maxi B only).

When reassembling the valve, pay attention that the shock absorbing ring is exactly seated in the valve recess and the tube lies under the clamping part.

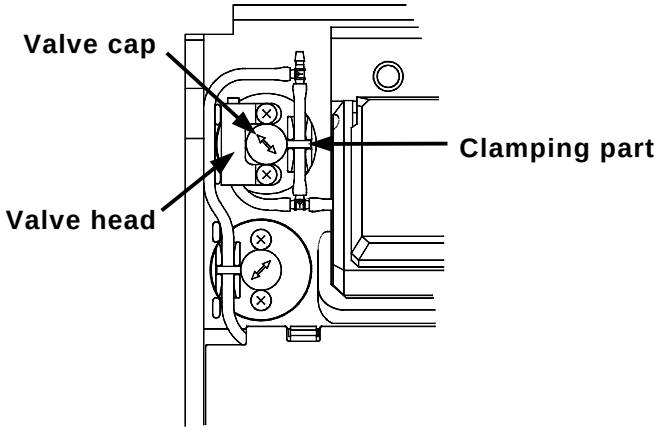


Fig. 8: V3 and V4 (analyzer version 2, 3, 5, 6, 8 and 9)

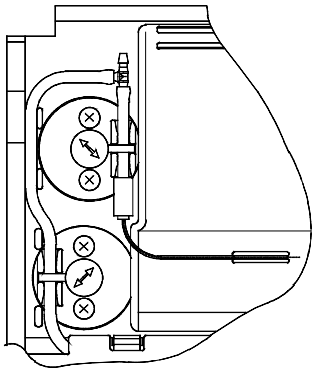


Fig. 9: V3 and V4 (analyzer version 1, 4 and 7)

AVL OMNI™ - front view

Analyzer cover removed, screen disassembled and measuring chamber plate opened up.

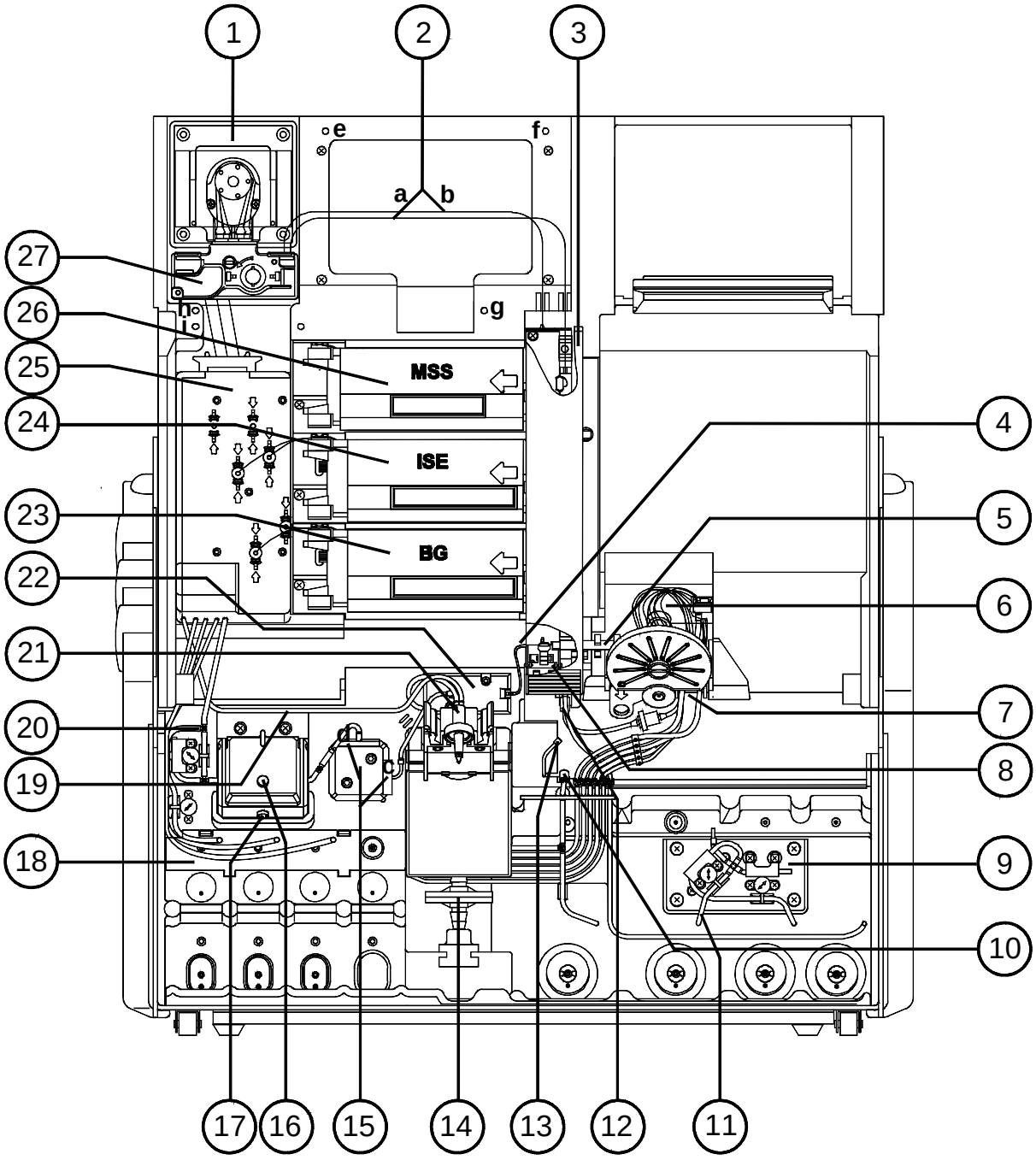


Fig. 10: AVL OMNI™ - front view

① ..... Peristaltic pump
② ..... Tubes to sample distributor
③ ..... Sample distributor with SD cartridge and SD cover
④ ..... Tube from sample distributor to tHb cartridge
⑤ ..... T&D sample inlet path
⑥ ..... T&D module
⑦ ..... T&D flap
⑧ ..... Bypass cartridge
⑨ ..... Fluid mixing system (FMS)
⑩ ..... Line for Solution A
⑪ ..... Connection for Solution B
⑫ ..... Second connection of the line for Solution A
⑬ ..... Bottle pipe III to the sample distributor
⑭ ..... Bacteria filter
⑮ ..... Hemolyzer and docking flange
⑯ ..... tHb measuring chamber and securing button or COOX measuring chamber and magnetic clip
⑰ ..... Measuring chamber releasing button
⑱ ..... Tubing cover
⑲ ..... Waste-tube
⑳ ..... T-piece
㉑ ..... Waste cap T2
㉒ ..... tHb cartridge or bottle compartment cartridge
㉓ ..... BG measuring chamber (AVL OMNI™ 1 to 9)
㉔ ..... ISE measuring chamber (AVL OMNI™ 4 to 9)
㉕ ..... Measuring chamber cartridge
㉖ ..... MSS measuring chamber (AVL OMNI™ 7, 8 and 9)
㉗ ..... PP cartridge

AVL OMNI™ - rear view

Screen tiped in forward direction, without vacuum pump and PC tower.

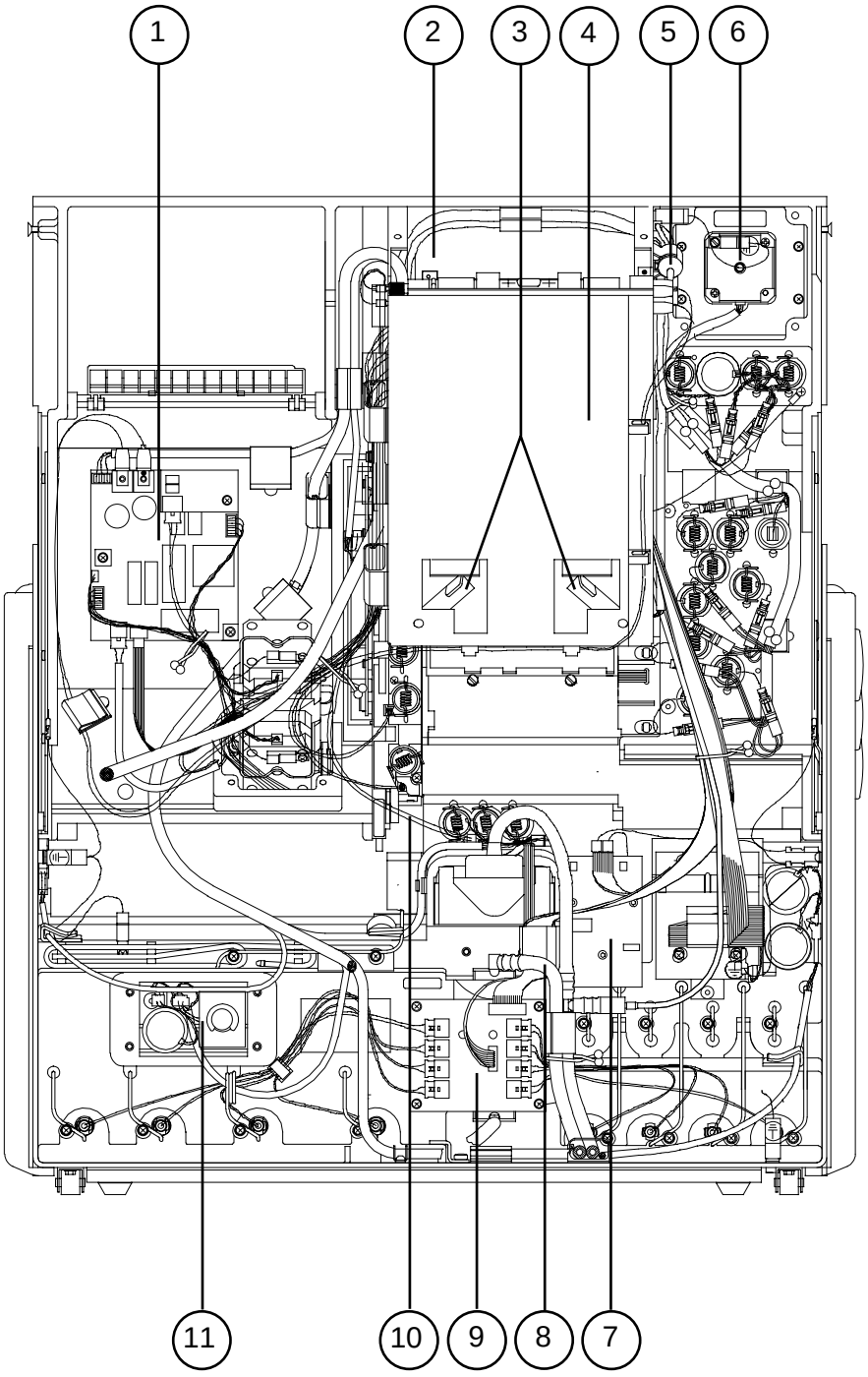


Fig. 11: AVL OMNI™ - rear view

① ..... T&D control
② ..... FLATIF (canceled at devices SN>1500)
③ ..... Ejection flaps
④ ..... Fan and filter
⑤ ..... Vacuum sensor
⑥ ..... Peristaltic pump (PP)
⑦ ..... Hemolyzer board
⑧ ..... connection tubes to vacuum pump
⑨ ..... Fluid level detector board
⑩ ..... Cable to sample sensor III
⑪ ..... Fluid mixing system (FMS)

Chapter 9 (Troubleshooting):

Valve Overload

This error flashes when the valve current is too high.

Valve defective? (check under "System – Test - Component Test – Valves")

no **yes**

Change valve (change see chapter 5).

If several valves are displayed, Mainboard may be defective ⇒ change Mainboard (change see chapter 5).

Manual revision 9.0, May 2000

Chapter 2 (Revisions): 81

modified chapters: all

applicable from software version: 5.5

Summary

Chapter - Page [1]	**Modification/Addition**
Cover page	Increase of revision number from 8.0 to 9.0
Contents	updated
1	Section “Device leakage current measurements - Testing after field repair and modifications” added
1-5	Section “Decontamination/Cleaning” updated
2-1, 2-2, 2-6	Revision numbers updated
2-5	Software version added (5.50)
3-7	• Resolution of Glu, Lac and Urea updated • BUN added • Footnote added
3-8	HTYPE under “Input values” deleted
3-16	Solution 6 added
3-18	• Solution 6 under “Environmental considerations – Reagents” added • Power consumption (max.) under “Electrical requirements” changed from 160 VA to 250 VA, text added • “Environmental considerations – Reagents” updated
4-2	Fig. 1 updated – Solution 6 added
4-5	Installation of Solution 6 (new cleaning solution) added
4-11	Text under “Shutdown procedure”, item 1 and 2 added
4-14	Text under item 2 (Installation of the AutoQC module) added
4-18	AVL OMNILink™ added
5-17	Text under “Changing the AQC maintenance kit” added
5-42	Text under “Changing the FMS air bubble trap” added
5-45	“Changing the Hemolyzer board” deleted
5-46	Table “Measuring module control MM” updated (Rocker switch 3)
5-47	“Barometer sensor” added
5-52	Disassembly of the SD cartridge under “Changing the BG measuring chamber” added
5-99 to 5-101	Table updated
5-104	Footnote under “PC board B486SLC“ added
5-111	Warning under item 8 (Changing the entire PC tower) added
5-116	Note under “Changing the PP head“ added
5-137	Fig. 66 updated – Solution 6 added
5-141	Fig. 68 updated (Valve bus) updated and note added

[1] Number of pages revers to Service Manual Rev. 8.0, November 1998

5-142	Table 1 (Valve and valve bus components) updated: • BV2181 replaced with BV2311 • YB2365 replaced with EP0053 • YB2366 replaced with EP0237
5-143	Text under “General information“ added
5-144	Table of valve connector positions added
5-147 to 5-151	Spacer replaced with spindle adapter
5-160	Fig. 86 updated – Solution 6 added
6	Sytem functions updated
7-25	“Cleaning” replaced with “Auto. cleaning with Solution 6”
7-26	Solution 6 added
8-1	Note under “Data storage” added
8-2	• “Changing the bacterial filter” transfered to section “Yearly maintenance” • Text added under “Changing the fluorescent lamps“ (Half-yearly maintenance) • “Changing the PP tubing“ and transfered to section “3-monthly maintenance“, text added
8-3	• “Changing the fill port”, • “Changing the aerosol trap”, • “Check sensor of Waste cap T2”, • “Check bottle spikes”, • “Check bottle connectors”, • “Check container tubes for Solution 2 and 4” under „Yearly maintenance“ added
8-5	• Changing of accumulator every 3 years added • Text added under “Yearly maintenance at AutoQC-module“
8-7	“Switches” replaced with “Switches 1”
8-12	▪ „Switches 2“ added ▪ Text under „Optics Test“ actualized
8-10	Text added under “BP Set” and “ Delete Data”
9	▪ New System warnings: “DB archiving !” “Check Cleaning Solution ! (Solution 6)” “Maintenance pending” “Perform Cleaning !” “Change PP Tubes !” ▪ “BG/ISE/MSS/ tHb/COOX parameter(s) not calibrated” added
9-1	“Date Invalid! Please Set Date/Time!” added
9-18	Text under “SS error + additional information” updated
9-32	Text modified under “AQC pos. Error” (If an AQC pos. error occurs, a number is printed on the service report.)
9-37	“BG/ISE: No Sample Detected” deleted
9-44	Text under “COOX HW error” updated
9-46	“COOX: No Sample Detected” deleted
9-48	“ISE: No Sample Detected” deleted
9-49	“MSS: No Sample Detected” deleted
9-53	“tHb: No Sample Detected” deleted
9-79	Fig. 8 (Valve error codes) updated and note added
9-87	Text corrected under 1P (C)
9-88	„Clean“ updated (Solution 4 deleted)
9.107	List of calibration flags extended
9-112	Table updated
	INDEX added

Chapter 2 (Revisions):

Electronic

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BA0866	Rev_6F	**Mainboard**		I56: XP0080 CS: $D2E7 I95: XP0082 CS: $843A I21/I77: XZ0109 CS: $73B6
BB0520	Rev_8D	**MC heat control**		
BB0532	Rev_11	**MC ceramic heater**		
BB0533	Rev_44	**Heat foil**		
BB0534	Rev_45	**MC cover heat control**		
BB0539	Rev_58	**Fluid level detector board**		
BB0548	Rev_5B	**T&D control**		I17: XP0079 CS: $EE78
BB0551	Rev_22	**tHb board**		
BB0555	Rev_67	**Motherboard**		
BB0582	Rev_45	**SD heat control**		
BB0584	Rev_02	**BFR board**		
BB0835	Rev_22	**Hemolyzer board**		I2:XP0263
BB0854	Rev_11	**Aktor Control**		I1:XP0223
BB0856	Rev_11	**Aktor Board 6XQK**		I1, 4, 6: XP0223
BB0857	Rev_22	**Aktor Board 14XPC**		I2, 4, 6, 9, 11, 13, 15: XP0223
BB0987	Rev_11	**Aktor Board V23**		I2: XP0223
BB0988	Rev_11	**Aktor Board V24/V02**		I2: XP0223
BB0986	Rev_11	**Aktor Board V19**		I2: XP0223
BB0984	Rev_11	**Aktor Board V04/V03**		I2: XP0223
BB0985	Rev_11	**Aktor Board V13**		I2: XP0223
BB0651	Rev_11	**T&D sensor board**		
BB0657	Rev_02	**Sensorprint-Waste**		
BB0663	Rev_13	**PolyOx-KX-Control**		I21 XP0139 CS: $CC93 I22 XZ0109 (3.04) CS: $73B6
BB0662	Rev_00	**PolyOx-Digital**		I5 XP0138 CS: $1318
BB0661	Rev_02	**PolyOx-Analog**		
BB0725	Rev_00	**PolyOx-Heat**		
EN0309	Rev_2.5	**B486SLC (AT96)**	SN > 1500	
EN0329	Rev_7.3	**AVLIFB (AT96)**	SN > 2566	
BB0722	Rev_22	**Display IFR**	SN > 1500	
BB0808	Rev_00	**IFR connector board**	SN > 2800	
EL0281	Rev_00	**TFT LCD converter**	SN > 2800	

EN0292	Rev_02	**Power supply unit**		
BB0739	Rev_22	**SSE (MSS) Amp Glu/Lac**		
BB0741	Rev_47	**SSE (MSS)-Mainboard**		
ZM0845	Rev_33	**SSE (MSS) flexprint**		
ZM0804	Rev_33	**SSE (MSS) connector board**		
BB0774	Rev_01	**SSE (MSS) contact print**		

AutoQC (Option)

Id. no.	Revision	Assembly group	Drawing no.	SW Id. no.
BB0760	Rev_13	**AQC control board**		I13: XP0177 CS: $2565 I23: XZ0145 CS: $65E0
BB0771	Rev_00	**YZ-distributor board**		
BB0772	Rev_01	**Z-distributor board**		

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